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MODIFYING THE TASK STRATEGIES OF IMPULSIVE CHILDREN

by

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To Charles Anderson For

Whom No Cow Is Sacred

ABSTRACT

Experimental evidence has indicated that cognitive impulsivity is implicated in a variety of learning problems. Children who are fast and inaccurate in the performance of tasks requiring choices to be made among closely matched alternatives are often the same children who experience difficulty in school-based material.

One possible reason for the poorer performance of cognitively impulsive youngsters is that they process information in a relatively haphazard fashion. Indeed, with regard to visual tasks, it has been demonstrated that "impulsive" children use less than adequate visual scanning strategies.

Two studies were designed to alter the visual processing strategies of "impulsive" youngsters in performance of the Matching Familiar Figures Test (MFF).

In Study I a televised model demonstrated a successful problem-solving strategy. The strategy was then applied to a set of practice problems by children in this experimental group. Another group of children used the practice materials but did not view the model. It was found that following a number of training sessions, the televised model (TM) group performed significantly more slowly and accurately on an alternate version of the MFF than either the material only (MO) group or the control group.

Study II was a partial replication of an experiment by Zelniker *et al.* (1972). While the MFF requires one to choose among six variants the one which is identical to the standard, the Discriminating Familiar

Figures Test (DFF) devised by the Zelniker group requires one to choose the single variant that differs from the standard. As an intervention technique it was reasoned that the DFF would force "impulsive" subjects to thoroughly scan the array before making a decision and that this effect would generalize to subsequent MFF performances. In accord with this prediction, it was found in the present study that following a series of DFF presentations, the experimental group was significantly slower and more accurate than the control group on a posttest MFF administration.

In neither study was there a generalized effect of MFF strategy modification to performance on a reading test and it was suggested that either the reading test was inappropriate due to a "ceiling effect" or that "cognitive impulsivity" is task-specific.

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TABLE OF CONTENTS

CHAPTER PAGE

CHAPTER PAGE

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

CHAPTER I

INTRODUCTION

As a result of a series of studies in the early 1960's (Kagan, Moss, & Sigel, 1963; Kagan, Rossman, Day, & Albert, 1964), Kagan and his associates became aware of marked differences in the preferred methods by which children of normal intelligence differentiated and analyzed external stimuli. Some children dealt with the stimulus array by reducing it to simpler components or features. Rather than attending to the global or most compelling features of the stimulus, these children characteristically dealt with its differentiated aspects. Categorization and integration of input in this manner has been referred to as the Analytic Attitude or Cognitive Style, by which is meant observed, intra-individual "consistencies in the mode of intake, processing and organization of material across a variety of stimulus situations" (Rossman, 1962). The nonanalytic cognitive style, on the other hand, describes a tendency to respond to the stimulus environment in a global and relatively undifferentiated manner.

A somewhat serendipitous finding emerging from these earlier studies was that underlying the analytic cognitive style dimension lay a more fundamental dimension of cognitive tempo. In short, faster response times on criterion measures were associated with global analysis, while slower response times were predictive of the more differentiating approach. The reliability of this observation has led Kagan to state:

> The data demonstrate the consistency of the analytic attitude across situations and suggest that the more fundamental processes of reflection versus impulsivity and visual analysis of complex arrays are primary determinants of the production of analytic concepts. (Kagan _et al_., 1964)

Kagan and Kogan (1970) have reviewed the research dealing with individual differences in directed thought as it occurs within a problem-solving framework. A question or problem, whether self-initiated or generated by an external agent, has the effect of marshalling thought processes such that the response will bear some semblance of coherence and logic. For heuristic purposes, Kagan and Kogan (1970) have described six discrete subprocesses of problem-solving behavior. These are:

1. Encoding (or decoding), referring to the understanding or recognition of the problem;
2. Memory, including both long- and short-term functions, representation and retrieval;
3. Generation of hypothesis or ideas, referring to the production of alternative goal solutions;
4. Evaluation of hypotheses or solution possibilities defining how a person will judge his cognitive products;
5. Deduction essentially refers to the implementation of a solution strategy;
6. Public report is the communication of the final product to an outside agency.

What Kagan and his associates had discovered was, essentially, that marked individual differences exist in the selection of solution hypotheses and in the evaluation of these cognitive products. Thus, some children pause to examine the quality of their thinking and likely reject many possible solutions before acting. These children are referred to as Reflectives. Other children, apparently of equal intelligence, do not seem to be concerned about accuracy and respond with the first solution

that seems feasible. These children are referred to as Impulsives. Characteristic differences in the processes of solution production and evaluation affect the entire range of problem-solving processes, including the accuracy of the initial perceptions, the accuracy of recall, and the quality of reasoning (Kagan, 1971).

Since the identification of conceptual tempo as a relatively stable problem-solving disposition, a large number of studies have indicated that impulsive children perform more poorly on a wide variety of problem types than do their reflective counterparts (Kagan & Kogan, 1970). In view of this, it required only one more step to speculate upon the possibility that children who respond too quickly in problem-solving situations might be the same children who have trouble in school. And indeed, quite a number of studies indicate that impulsive subjects do not perform as well as reflectives in various areas of reading, arithmetic, and in general school achievement.

In addition, recent research has suggested the possibility that the cognitive tempo dimension of impulsivity is related in some ways to the behavioral syndrome of impulsivity or hyperkinesis (Keogh, 1971).

In view of the possible debilitating effects of impulsive responding, a growing body of research has been focused upon developing ways of modifying the impulsive cognitive tempo. To this point, cognitive tempo has remained curiously resistant to modification procedures, and while a few programs have proved successful (e.g., Meichenbaum & Goodman, 1971; Spector, 1974), many more have not.

The primary goal of the present research is to develop a viable method of modifying the fast, inaccurate responding of impulsive children with the hope that it might be adapted to school-based material.

CHAPTER II

REVIEW OF RESEARCH

Reflection-Impulsivity: A Definition

Theoretically, the conceptual tempo dimension of Reflection-Impulsivity is defined as the degree to which a child reflects upon the validity of his alternative solutions in situations having a high degree of response uncertainty. When attempting th solve problems requiring fine discriminations among closely matched alternative solutions, Impulsive subjects, in contrast to their Reflective counterparts, tend to respond more quickly and commit a higher rate of errors. Reflective subjects tend to proceed more slowly, carefully consider more alternatives, and commit considerably fewer errors.

Measurement of the R-I Dimension

The conceptual tempo dimension of Reflection-Impulsivity has been defined operationally using a number of measures among which there are substantial correlations (Kagan et al., 1964; Kagan, 1965b, 1966).

Conceptual Style Test (CST)

This test consists of 30 stimuli cards each illustrating three line drawings of familiar objects (e.g., zebra/shirt/striped shirt). The subject is asked to select two figures that are alike and to state the reason(s) for his choice. Items are constructed such that an analytic concept is in competition with an inferential-abstract or thematic concept. Scoring is based upon the total number of analytic concepts and the average time taken to select a concept.

Delayed Recall of Design Test (DRT)

In this match-to-sample test, subjects are presented with black and white line drawings of geometric designs for a period of five seconds.[1] The standard is then removed and after a period of fifteen seconds the subject is presented with an array of eight, nine or ten similar items and asked to choose the one identical to the standard. Scoring is based upon the total number of errors and the average response time to the initial selection.

Haptic-Visual Matching Test (HVM)

In this test the subject must explore with his finger a form to which he has no visual access. When exploration is complete, the subject is presented with a visual array of five stimuli. The task is to recognize the form that had been explored haptically. The dependent variables on this test are mean response time to the first selection, total number of errors, and palpation time (i.e., time spent in tactual exploration).

Matching Familiar Figures Test (MFF)

The format of this test is similar to that of the DRT but without the memory factor. Of all the measures used to operationalize the R-I dimension, Kagan (1965c) has noted that the MFF provides the highest degree of response uncertainty and when correlated with external criterion variables usually yields the highest coefficients (Lee, Kagan,

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[1] These stimuli were originally used by the Gibson group at Cornell in studies relating to reading (see Gibson, Gibson, Pick, & Osser, 1962).

& Robson, 1963). The subject is shown a picture of a familiar object (the standard) and six alternatives, only one of which is identical to the standard. The subject is then required to select the identical alternative and scoring is based upon the total number of errors and the mean response latency to the first selection. It should be noted that a maximum of six errors is allowed on any trial, after which the subject is shown the correct answer.

Pervasiveness

The various measures of R-I have been administered to children of different ages in a number of studies (Kagan *et al*., 1964; Kagan, 1965a, 1965b, 1965c, 1966; Kagan & Kogan, 1970). In general, the results have indicated that the dimension is relatively stable over time and has a degree of generality across tasks. More specifically, the results of these studies indicate:

1. Over the age range of 5 to 11 years, a dramatic increase in response latency occurs with increasing age. Concomitantly, there occurs a marked reduction in the number of errors. At each age level a sizeable negative correlation exists between latency and error scores ranging from -.40 to -.65 (*ps* .01).
2. Cross-task generality was usually high, with error correlations among MFF, HVM and DRT ranging from .33 to .52, and latency correlations ranging from .48 to .82. Despite the moderate intercorrelations among measures of the R-I dimension, Kagan (1965b) has indicated that the Matching Familiar Figures Test provides the greatest utility since the "MFF has the greatest response uncertainty and yields the highest correlations with external criterion variables (p. 617)".

3. The test-retest reliability of the MFF has been assessed over varying periods of time. In general, the stability of the test is adequate. Yando (1968) had a group of second grade children perform the test on a weekly basis over a ten-week period. Initially only the standard and two variants were presented to each child. One variant was added each week to a total of 12. The average correlation for response time was .70. The finding essentially supports that of Kagan, Pearson, and Welch (1966a) who reported similar results (r = .70) for a test-retest on alternate forms of the MFF after a ten-week interval. Reliability studies over longer periods of time have illustrated the continuity of the R-I dimension as measured by the MFF. Kagan et al. (1964) administered the MFF to a group of third and fourth grade children at the beginning of one school year and again a year later. The average response time correlation was .62. Similarly, using matched versions of the MFF, the average correlation was .50. Longer intervals, however, reduce MFF stability considerably, with Messer (1968) reporting a correlation of .31 following a two-and-one-half year hiatus.

In sum, it seems evident that the tendency to respond quickly or slowly on tasks involving choices among closely matched alternatives has a fair degree of generality across tasks and stability over time.

It should be noted in passing that while Kagan conceived the R-I dimension to be related to response speed, he also believed that latency had a bearing upon accuracy, hence the consistent negative correlation with fast children presumably making more errors and the slow children making correspondingly fewer errors. A certain degree of "noise in the

system", however, was created by two small but anomolous groups who were either both fast and accurate or slow and inaccurate. The former group contained "bright subjects who can have relatively fast response times on easy tasks but make few errors (Kagan, 1966, p. 503)". The latter group was made up of children in whom the test evokes such a high level of anxiety over the possibility of committing an error that their performance suffers.

To eliminate these two groups, a scoring system using a combination of speed and accuracy scores was devised. Impulsives are thus categorized as children scoring below the median response time and above the median error score. Conversely, Reflectives are described as those children having longer response times and fewer errors.

It is a pity that in the search for a "purer" method of categorization two enormously interesting groups have been excluded from the mainstream of research dealing with the R-I dimension. Are there, for example, major differences in the ways in which Fast Accurates process information? Or is it simply that they have less fear of making a mistake than the Reflective group and thus arrive at the implementation phase more quickly? Are fast-accurate children simply more intelligent? If, as Kagan suggests, slow and inaccurate children do poorly due to an overwhelming fear of failure, would it be possible to reduce the anxiety level of these children, and, if so, would lower anxiety produce a concomitant increase in the level of performance?

Antecedents of the R-I Dimension

A number of explanations have been forwarded to account for the fact that some children are slower and more accurate than others in the performance of match-to-sample tasks. The first of these, suggested by Kagan (1965), indicates the possible influence of constitutional or genetic predispositions upon cognitive tempo. These predispositions may be of at least two types. The first of these relates to a heritable trait which manifests itself in either a fast or slow cognitive tempo. The second speculates that impulsivity might be "a partial consequent of subtle cerebral insult early in life (Kagan _et_ _al_., 1964, p. 33)". Thus, minimal brain damage occurring during the perinatal or early post-natal period might give rise to excessive motor behavior and distractibility during the early school years. Campbell (1969) has demonstrated that hyperactive children with severe attentional difficulties were more impulsive than normal children on the MFF. It is not clear, however, whether the hyperkinetic syndrome and the R-I dimension are related or whether hyperactive children and cognitively impulsive children obtain similar scores on the MFF but for different reasons. It would be of interest in this respect to discover whether teachers' ratings of over-activity had any predictive value vis a vis scores on the MFF.

Schwebel (1966) has indicated that impulsive children have an inordinately large representation among poorer class families. With respect to this finding, Kagan and Kogan (1970) suggest that since the incidence of both pre- and perinatal trauma is higher among poor families, the possibility of subtle cerebral insult to the brain stem and consequently to the inhibition system is increased. Tangentially

in support of this hypothesis, a recent series of studies (e.g., Dobbing & & Smart, 1974) have implicated malnutrition in brain development anomalies. For example, in lab rats which had been undernourished, the development of the cerebellum region was less than normal. The cerebellum among other things is implicated in body image and balance. Consequently, the malnourished sample had a marked lack of capability in feats of balance common to the normal rat. Although evidence here is still of a very tentative nature, it is well known that poor balance and body image are often associated with learning problems in children and that learning problems occur more frequently among poorer children.

More direct evidence for the possible genetic basis of cognitive tempo and inhibition is supplied by Kagan (Kagan & Kogan, 1970) who notes that among four-month-old infants, those who demonstrated slower rates of habituation to a series of pictures of achromatic faces tended to be larger, fatter, and smiled more often than fast habituating children. Kagan further points out that: "In addition both body size and frequency of smiling during the first half year display greater similarity between monozygotic than between dizygotic twins (Kagan & Kogan, 1970, p. 1319)."

Kagan (1966) has studied a group of male infants over a two-year period (specifically at ages four months, eight months, 15 months and 27 months). He found that those infants who quickly habituated to a series of pictures at four months tended to remain at a particular play activity for considerably shorter periods of time at eight, 15 and 27 months of age than those children who had been slow in habituating to the pictures. In addition, Pederson and Wender (1968) found that children two-and-one-half years of age showed marked differences in

the amount of time spent with a particular plaything. Furthermore, a follow-up study conducted four years later indicated that those children having longer attention spans during the earlier study performed better on those subtests of the Wechsler Intelligence Scale for Children (WISC) which contained a degree of response uncertainty (e.g., Picture Arrangement and Mazes).

While the above findings might equally well be explained in terms of differential experience, Kagan and Kogan (1970) seem more in favor of the genetic hypothesis and cite two behavioral genetic studies by Rappucci as providing some support for this viewpoint. In one study, monozygotic and dizygotic pairs of twins were observed during free play at eight months of age. The critical variable in this study was the tendency to switch activities during the first four minutes of play. This tendency was shown to have a strong heritable component. In a second study, 61 pairs of female fraternal and identical twins aged from six to ten years were observed while playing games. One critical variable was the time required by a child to select a toy. It was demonstrated that identical twins obtained a much higher interclass correlation (.88) than did fraternal twins (.28) on a global rating of apprehensiveness (a partial measure of decision time), thus indicating that conceptual tempo may have genetic antecedents.

A second possible antecedent condition underlying the R-I dimension suggests that children in problem-solving situations respond with anxiety to a variety of situational cues (Kagan & Kogan, 1970). Children having minimal anxiety in such situations might be expected to adopt a task strategy which was neither reflective nor impulsive. Reflective subjects

presumably equate competence with accuracy, thus they perform slowly. Impulsives, on the other hand, view competence in terms of quickness, hence their fast performance. In situations, then, where anxiety over competence is aroused, reflective and impulsive subjects would be expected to respond in characteristic fashion. Little evidence seems to exist in support of the foregoing hypothesis, while a partial refutation is apparent in the results of two studies (Ward, 1968; Reali & Hall, 1970). In both of these studies, feedback regarding the quality of performance was given. Though expectation based upon the above hypothesis would be for an increase in speed among impulsive subjects in response to failure feedback, this did not occur. In fact, reflective subjects increased their response latency in response to communication of failure.

A more parsimonious (and more plausible) explanation of factors underlying conceptual tempo again implicates anxiety. Kagan and Kogan (1970) have suggested that there exists a direct relationship between anxiety over error and reflectivity. In this view, then, the performance of the impulsive child reflects his lack of concern over making mistakes.

The above hypothesis is supported by two lines of evidence. The first deals with the data from eye-track recording supplied by Drake (1968) and Siegelman (1969). In both of these studies it was indicated that impulsive subjects ignored two-and-one-half times as many variants on a match-to-sample task than their reflective counterparts. In addition, impulsives tended to deal with each visual presentation in a global, nonanalytic manner and thus used less information upon which to base their choices. In view of this, one might speculate that the

riskier strategy of impulsive subjects is based upon an underlying lack of concern over possible errors. Reflective subjects, on the other hand, use a more cautious strategy, take longer, and consequently avoid errors.

Additional support for this explanation is supplied by Messer (1968). In this study, third grade boys categorized as reflective or impulsive were placed in one of three experimental groups: (1) a "failure induction" group in which children were administered a difficult anagram test and were led to believe that they had not performed well; (2) a "success" group which did the same test but were told that they had done well; and (3) a "control" group which received neither "success" nor "failure" feedback. All children were then administered a matched version of the MFF. Among the success group, both reflective and impulsive subjects increased their response speed on the posttest, while both the failure and control groups became slower. In addition, increased response latency was accompanied by a decrease in overall error rate. It should be noted that speed and accuracy changes among control children, in the absence of information to the contrary, interpreted the second testing as an indication of failure during the initial session. Messer (1970) lends support to the efficacy of this notion.

Before accepting this position out of hand, however, it is of value to consider some predictions drawn from it. For example, one would expect no change in the performance of impulsive subjects in response to report of failure, a speeding-up of reflective performance in response to success reports, and a slow-down in response to failure. Research findings have not always been consonant with the above predictions.

In Messer's (1968) study, for example, impulsive boys in both the failure and control groups increased their response latencies during the posttest. Assuming that impulsive children experience minimal anxiety over committing errors, this finding does not concur with expectations.

Ward (1968) administered a number of R-I measures to a group of kindergarten children under two experimental conditions. In the first condition, subjects were led to believe that they were doing poorly. This point was emphasized by giving them a marble for each correct trial and taking one away for each error. Children were told that if they could accumulate enough marbles, they could use them to buy prizes at the end of the session. In contrast, the second condition involved a relaxed, nonevaluational attitude, liberal use of praise and no error feedback. Ward found that following an incorrect response, the response latencies of both impulsive and reflective subjects increased and, surprisingly, the effect was most consistent among impulsive subjects. These findings are in general agreement with those of Reali and Hall (1970) but are not predicted by Kagan's "lack of anxiety over errors" hypothesis. Nor are these findings (as mentioned earlier) consonant with the "competency" hypothesis which would predict an increase in the speed of impulsive responding following failure.

A fourth possible antecedent of conceptual tempo has been proposed by Reali and Hall (1970) who suggest that impulsive subjects use less information as the basis for making decisions among closely-matched alternatives than do reflective subjects. And a number of recent studies (e.g., Siegelman, 1969; Drake, 1970; Zelniker, Jeffrey, Ault, & Parsons,

1972) have demonstrated that reflective children do in fact make use of different, more efficient and more thorough scanning strategies than those used by impulsive children. Research bearing upon the efficacy of the above proposal will be dealt with more thoroughly in a later section of the present review.

Correlates of the R-I Dimension

The discussion to this point has provided grounds for the conclusion that operational definitions of conceptual tempo have a certain degree of convergent validity and reliability. In addition, a number of possible antecedents of the cognitive tempo dimension have been considered. The next section seeks to determine the nature of the relationships of the R-I dimension to other aspects of human performance.

R-I and sex differences

Many studies in the R-I literature have grouped subjects such that any possible effects of sex differences are controlled. Despite these precautions (or perhaps due to them), the relationship of gender to conceptual tempo is unclear. Kagan (1965a) found reading scores to be more highly correlated with MFF response latency for boys, while for girls reading and MFF accuracy scores correlated more highly. Although Lewis, Rausch, Goldberg, and Dodd (1968) found no sex differences in either response time or accuracy, they found errors to be more highly related to IQ for girls, while boys' IQ scores correlated more highly with response latency. Kagan and Kogan (1970) have responded to the above type of finding by suggesting that: "Sex differences in level of performance on varied intellectual tasks are less common than in

the pattern of relations among performances (p. 1316)." To substantiate this suggestion, they draw on Maccoby's (1966) proposal that the personality dimension of inhibition-impulsiveness is curvilinearly related to quality of intellectual performance. Maccoby indicates that boys and girls occupy different positions on this dimension, with extremely inhibited girls and extremely impulsive boys demonstrating the lowest quality of intellectual performance. As girls become less inhibited and boys become less impulsive, the quality of performance improves. If one may assume that boys are more willing to risk error than are girls (Wallach & Caron, 1959), then the implication in Maccoby's (1966) hypothesis may be that sex differences on intellectual tasks may occur as a result of different attitudes toward the possibility of making a mistake. However, linking behavioral impulsivity to the R-I dimension even by analogy is risky since, as we shall see, no clear relationship has been shown to exist between the two dimensions (see, for example, Keogh, 1971). A direct test of the Maccoby hypothesis has been attempted by Garner, Percy, and Lawson (1971) who investigated both behavioral impulsivity and conceptual impulsivity in relation to intellectual performance. Although they found boys to be more behaviorally impulsive than girls, no support was obtained for any deductions drawn from Maccoby's hypothesis. With regard to the R-I dimension, there was no indication of sex differences.

Cathcarte and Liedtke (1973) and Souch (1970) have found consistent sex differences in both response times and errors on the MFF. In view of the movement toward greater reflection with age, one might speculate that sex differences in cognitive tempo are a function of differential

rates of maturity between boys and girls.

It would seem that simple, quantitative data about sex differences will not provide informative answers of any breadth. What is needed are questions which will generate qualitative information about the relationships among various personality variables, sex and cognitive tempo. An analysis of such microvariables as visual scanning strategies might be illuminating. Do females, for example, scan the visual array in ways that are characteristically different from males?

Until a clear statement can be made, however, it is perhaps wise to heed the advice of Souch (1970) and "continue the practice of analyzing the data separately for the sexes (author's abstract)".

R-I and social class

The available literature bearing upon the relationships between socioeconomic status and the R-I dimension demonstrates a series of ambiguous findings. The reason for this may perhaps reside in the poor definition of "social class" and the confounding of this concept with that of "race".

Zucker and Stricker (1968), for example, investigated the differences in conceptual tempo between lower-class negro and middle-class Caucasian children, thus confounding race and social class variables. Their findings, however, are compatible with those of a number of other studies using either Caucasian or negro samples, i.e., there is a tendency for the more affluent populations to be more reflective than the less affluent.

Schwebel (1966) has suggested that impulsive responding by lower-class children accounts for the lesser language competence of these

children when compared to middle-class groups. On both verbal and conceptual tasks, lower-class children often seemed to pay little attention to instructions and frequently responded before instructions were completed. In view of the fact that by forcing these children to "stop and think" before responding their performance improved, Schwebel suggests that the poorer performance of lower-class children was at least in part due to impulsive responding. Another suggestion, however, might be that class differences exist in the interpretation of the instructions or demand characteristics of the situation.

Campbell (1968) and Souch (1970) found that impulsive students were significantly over-represented in schools located in lower-class catchment areas. Both of these investigators, using the Blishen Scale of Canadian Occupations as a measure of socioeconomic status, found a direct relationship between this measure and impulsivity.

The aforementioned relationship was not found by Yando and Kagan (1968) nor by Gupta (1970), suggesting the need for more clarity in this area.[1] The notion of social class definitely needs clarification in view of the possibility that "middle-class black" does not mean the same thing as "middle-class white" since the interaction of money, status, and culture may have quite different meanings in each group. It would be of interest to consider class differences in child-rearing practices, parental expectations and achievement orientation, while holding

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[1]An interesting review of the "middle class" concept has recently been published by Heilbroner (1976). In this article, the author suggests that many of those who think of themselves as middle class are simply fooling themselves. Such an analysis may cause the cautious researcher to "think twice" about the content of such indicators of social class as the Blishen Scale of Canadian Occupations.

constant such potentially confounding variables as IQ, race, language facility, etc.

R-I and intelligence

In spite of earlier assertions attesting to the orthogonality of intelligence and conceptual tempo (e.g., Kagan et al., 1964), the relationship between the two still remains unclear. And it is an area where clarity is essential since, as Mischel (1969) has indicated, if correlations between cognitive style variables and measures of intelligence exist to any degree, then one must question the extent to which the stability of the cognitive style dimension is due to association with intelligence: "To the extent that conceptual tempo involves reaction time, and fast reaction time is a determinant of generalized performance IQ, one would have to be alert to their inter-relations . . . (p. 1013)."

West (1973) found a significant curvilinear relationship between MFF latencies and WISC full scale IQ scores. His data indicated that highly impulsive boys on the average are about 9 scale points lower on overall IQ scores than are highly reflective boys. The finding did not obtain for girls. In addition, highly impulsive children performed better on the Performance subtests relative to both their own verbal scores and to the Performance scores of reflective subjects. The reverse was true of reflective subjects and superior verbal scores. In effect, what West has demonstrated is that, contrary to the Kagan and Kogan (1970) assertion that "there is generally a low, usually non-significant relation between language skills and this dimension (p. 1310)", a substantial relationship exists, indicating that highly impulsive children perform more poorly on verbal tests. The finding that highly impulsive children

are superior on Performance tests substantiates Mischel's (1969) suggestion concerning reaction time and generalized performance IQ. Plomin and Buss (1973) and McLauchlan (unpublished manuscript), however, not only did not replicate West's (1973) findings, but in fact had results indicating that impulsive subjects perform more poorly than reflectives on such subtests as Block Design, Object Assembly and Picture Arrangement. One might speculate that these seemingly contrary findings might accrue from the different methods by which various groups were selected. West concentrated only on the speed variable, arranging subjects along a temporal continuum. By definition, the impulsive subject is one who makes choices quickly and commits many errors. Thus the bulk of research has used the double-median split scoring method, allowing for the removal of fast/accurate and slow/inaccurate groups. West's impulsive group might therefore have benefited from the performance of fast and accurate subjects on the Performance subtests, since the focus of scoring is upon accuracy with bonus points for speed. Impulsive groups in the Plomin and Buss (1973) and McLauchlan (unpublished manuscript) studies were, by definition, inaccurate and thus could not benefit from their faster response times.

Eska and Black (1971), in an extensive study of the relationship of the R-I dimension to measured intelligence, have demonstrated convincingly that one should hesitate before asserting the orthogonality of the two constructs. It should be emphasized, however, that in most of the studies where significant correlations were found, IQ measures had formats structurally similar to that of the MFF test (e.g., Meichenbaum & Goodman, 1969; Souch, 1970; Gupta, 1970; Eska & Black,

1971). This, of course, might be an important finding in its own right, since there is widespread use made of such tests as the Lorge-Thorndike and the Otis-Lennon in our school systems. And one's score on these tests could be due largely to whether or not one is impulsive.

In general, the foregoing results indicate that the relationships between the R-I dimension and intelligence requires further clarification. It is not clear, for example, whether or not impulsives are simply less intelligent than reflectives, or whether given similar verbal IQ scores there would be differences in impulsive and reflective performance on such multiple-choice tests as the Raven's Matrices.

Reznik (1975) has made an interesting suggestion to the effect that a long history of impulsivity might have a generalized adverse effect upon cognitive functioning and it would be of interest to determine whether the performance of older impulsive subjects would be more impaired across a variety of cognitive tasks than would the performance of younger impulsives.

In general, of the relationship between cognitive impulsivity and measured intelligence, it might be stated simply that more research is needed and that until definitive answers are forthcoming, it will be necessary to control for the intelligence variable in cognitive tempo research.

R-I and the educational setting

A growing number of research findings indicate that the adequacy of performance on a number of school-related tasks is to some extent a function of cognitive tempo.

In the area of problem-solving, for example, consistent qualitative

differences have been shown to exist between the performances of reflective and impulsive children (Ault, 1973; Denney, 1973; McKinney, 1973; Adams, 1972). Using Mosher and Hornsby's (1966) "Twenty Questions Procedure", Denney (1973) and Ault (1973) have demonstrated that impulsive children tend to use less mature questioning strategies than their reflective counterparts. The Mosher and Hornsby procedure elicits two primary approaches to questioning. These are described as either "hypothesis-seeking" or "constraint-seeking" strategies. The former tends to involve random questioning and lacks continuity from one question to the next. The latter takes the form of more global questions which effectively narrow the range of possible follow-up questions (e.g., "Is it an animal?" or "Can it be eaten?"). Mosher and Hornsby (1966) found that the tendency to use constraint-seeking questions greatly increased with age. In addition, a concomitant decrease in the use of hypothesis-seeking questions was observed.

Both Denney (1973) and Ault (1973) found that reflective subjects made significantly more use of the constraint-seeking strategy and were thus seen as being more sophisticated in their approach to questioning. In addition, Ault noted a developmental trend such that younger reflectives achieved Twenty-Questions scores equivalent to those of older impulsive subjects. It should be noted, however, that while one study (Denney, 1973) found MFF latency scores to be associated with measures of conceptual strategies and accuracy scores to be unrelated, another study (Ault, 1973) found exactly the opposite effect.

It is clear that, while a strong cognitive developmental component seems to underlie the child's preference for one or another type of

conceptual strategy, the role of the cognitive tempo dimension of reflection-impulsivity remains to be clarified.

The R-I dimension has also been implicated in various aspects of reading performance. Kagan (1965a), for example, found that impulsive first grade children made more errors on word and letter recognition and on oral reading tests than did reflective children. The relationship between R-I and reading accuracy maintained after the influence of verbal skills had been partialled out. Similarly, Roettger (1971) found reflectives to be more accurate than impulsives on a word discrimination test. In this study, impulsive and reflective kindergarten children were assigned to either of two treatment conditions or to a control group in order to assess the possible effects of scanning training upon performance. One group was taught a scanning strategy that required subjects to match words with the standard, letter by letter. A second group had no scanning training but simply matched word choices with the standard. A "posttest" session using an alternate form of the same test indicated that, while both treatment conditions increased latency and decreased error, the strategy-training group had the greatest gains. Similarly, Kalash (1972) found a relationship between conceptual tempo and reading readiness in first grade disadvantaged children. In this study, reflective children scored significantly higher on a measure of reading readiness than did impulsive age-mates.

Analyzing data according to Goodman's taxonomy of reading miscues, Butler (1972) found that, while reflective and impulsive second grade subjects did not differ in the number of miscues committed on an oral reading test, the latter group made significantly fewer repetitions and

corrected a lesser percentage of miscues than did the former group. In addition, MFF response time correlated positively with respect to the percentage of miscues corrected, while MFF error scores showed a negative correlation, suggesting that reflective children are more likely to be concerned about the adequacy of their performance following the experience of failure.

While a considerable body of research indicates that cognitive impulsivity is implicated in various aspects of poor reading performance among primary grade children, it should be emphasized that these findings are not all in agreement. King (1972), for example, noted that grouping first grade children according to cognitive style had no predictable effect upon reading progress, nor were there significant trends to most gains, even by the fast/accurate MFF group. The lack of significant findings in this study and those of a similar study (Woker, 1970) were tentatively related to the lack of response uncertainty inherent in primary grade reading tests. Plausible as this explanation may be, it does not explain the relationships found by other investigators. It does, however, highlight a serious problem common in R-I research. Very few studies use identical criterion tests, thus rendering comparisons with other studies virtually meaningless.

The relationship of R-I and reading ability in older elementary children has been accorded much less attention in the research literature. Only two studies have in fact dealt directly with this issue (Johnson, 1969; Lesiak, 1970), and these findings are essentially in opposition. Lesiak (1970) compared the performance scores of first and fifth grade reflective and impulsive subjects on word recognition, reading

comprehension, critical reading, and rate of comprehension as measured by a variety of standardized tests. Her findings revealed that among first grade children, those who were extremely reflective on the MFF performed in a superior manner to those who were extremely impulsive on a number of the criterion tests. It should be noted, however, that there exists a number of problems inherent in the procedure of separating extreme groups for the purpose of comparison. No reading achievement differences were found between reflective and impulsive fifth grade subjects, a finding contrary to that of Johnson (1969) where sixth grade boys grouped according to conceptual tempo scored significantly differently on two measures (reading grade point average and the reading vocabulary subtest of the California Achievement Test).

Clearly, additional research is warranted in this area. It would be of interest, for example, to determine whether those children who were rated as impulsive/poor readers in the earlier grades continued to be so during later grades. Or if, in fact, as Lesiak's (1970) research suggests, R-I and reading scores are not related in later grades. What is it that impulsive children have done to overcome their apparent earlier reading deficits? It has been well documented that MFF scores are directly related to age such that children tend to slow down and become more accurate as they grow older. Apparently, this is a natural developmental trend occurring among children regardless of their initial position on the R-I continuum. Children become more reflective. But they do so at differing rates. It is entirely possible that reading skills reflect similar developmental trends. Thus, attempts to artificially alter cognitive tempo in the hope of effecting a

concomitant improvement in reading scores might be superfluous. If reading scores of reflective and impulsive children are essentially alike in later elementary grades, why attempt to alter their relative positions during earlier grades?

Research relating reading scores to cognitive tempo might be summarized thus: A majority of studies indicate that impulsive children perform more poorly on a variety of reading tests during early elementary years. This trend is not at all apparent for older children and more research is needed to clarify the issue. In addition, it seems fair to say that clarification of possible relationships between reading and the R-I dimension will require something more than gross correlations. Such underlying variables as visual scanning strategies, attention deployment, differential task involvement, attention span, etc. are therefore of critical interest.

The quality of inductive reasoning has also been associated with the R-I dimension. Kagan, Pearson, and Welch (1966a) presented children with two types of problems. In one situation the child was given three attributes of a common object and then was asked what the object was. In another, each child was presented with a series of pictures arranged thematically. The task was to complete the story by adding a final picture. On both tasks, impulsive children responded more quickly and made more errors.

Cathcart and Liedke (1969) hypothesized that reflective students would be higher achievers in mathematics than would impulsive pupils due to their tendency to consider the quality of their answer before responding. In this study, reflective pupils did indeed obtain higher

mathematics achievement scores, thus lending credence to the authors' hypothesis.

Messer (1970a) found that children who had failed a grade were more impulsive at the beginning of grade one and remained more impulsive as a group 30 months later compared with children who had not failed a grade. Gupta (1970) found reflectives to have generally higher school grades than impulsives. This relationship, however, did not obtain in a study by Campbell (1968). Keogh and Donlon (1972) have indicated that children who manifested serious learning and behavioral disorders were more impulsive when compared to children having less serious learning handicaps. It is not clear, however, whether the seriousness of the disorder contributed to the MFF test score. For example, a seriously overactive child might not deal with the visual array at all but simply respond arbitrarily.

It would seem, in view of the foregoing, that the R-I construct might contribute important insights into a variety of learning problems, not the least of which might be school failure. Keogh (1971), in a recent review article, has proposed three hypotheses to explain learning problems in hyperactive children. One of these suggests the possibility of implicating the R-I dimension. Essentially, Keogh's position is that "hyperactive children are considered to lack thoughtfulness, to respond too quickly, to lack the ability to think things through, and to be unable to delay response (p. 106)".

That cognitive impulsivity is linked to the behavioral syndrome of hyperactivity is a potentially fruitful hypothesis. In fact, Kagan et al. (1964) have made a similar suggestion. To date, however, there has been

little "hard data" brought to bear on the issue. Bjorkland and Butter (1973) found minor hyperactivity not to be a predictor of Reflection-Impulsivity, a finding in general agreement with that of Keogh and Donlon (1972) and McLauchlan (unpublished manuscript). The latter study showed no relationship between teachers' ratings of children's activity level using David's (1970) rating scale and scores on the Matching Familiar Figures Test.

Severe hyperactivity, on the other hand, has been shown to be associated with cognitive impulsivity (Campbell, 1973; Keogh & Donlon, 1972). Once again we are faced with a situation where gross correlational data will not provide definitive answers. Comparisons of variables underlying the two constructs of hyperactivity and cognitive impulsivity might prove to be more fruitful sources of information. For example, when dealing with complex visual tasks, do both groups demonstrate similar patterns of eye movements? Kagan (1965) has indicated that impulsives make many more eye movements in comparing variants to standard on the MFF. In addition, these movements do not seem to be of a systematic nature. This finding is in general agreement with that of Turnure (1970) and Carrier et al. (1967) who found that poor learners made substantially more extraneous head turnings and eye movements than did good learners. A plausible hypothesis, it seems, is that both impulsive children and poor learners lack the ability to direct eye movements in a purposive manner and to delay responding. Thus they make less than optimal use of available information. Drake (1970) lends support to this notion, demonstrating that reflective children "directed more of their regard and looked at larger portions of the stimulus material than did impulsive

children (p. 211)". Hallahan et al. (1973) compared high and low achieving children on the MFF and Hagen's Central-Incidental Task. It was found that low achievers were more impulsive and attended less selectively than high achievers: "Correlational data suggests that the two measures are related. Impulsivity and inability to ignore irrelevant information indicate a deficiency in the control of attention (pp. 565-566)."

In the foregoing, highly selective review, the relationship of the cognitive tempo dimension (Reflection-Impulsivity) to such school-related issues as learning disabilities, hyperactivity, intelligence, socio-economic status, etc. has been examined. None of the results are conclusive, none may go unchallenged. But what does develop is a certain "feel" for the generality of the R-I dimension.

Modifying the Impulsive Tempo

Delay and reinforcement

In view of the apparent endurance of the Impulsive or Reflective attitude and its forcefulness as a variable in cognitive performance, a number of attempts have been made to modify performance on this dimension. Primarily, these attempts have focused upon the modification of impulsive responding.

To digress for a moment, the initial concept of the R-I dimension was of a relatively stable aspect of cognitive tempo underlying the Analytic-Nonanalytic cognitive attitude. The quality of analysis was thought to be in large part a function of the time spent on a given task. It was found that the accuracy of performance on R-I criterion

tasks was generally negatively correlated with response speed. By implication, then, it seemed reasonable to expect that by increasing the response latency of a given subject, a concomitant increase in accuracy would occur.

Kagan et al. (1966a) had subjects delay their responses for a period of 15 seconds. It was demonstrated that following a series of training trials, the impulsive experimental group took significantly longer to respond on an equivalent post-treatment task. This finding was substantiated by Alason (1969) who told children to "stop and think" before answering. In an interesting study, Briggs and Weinberg (1973) attempted to modify the response latencies of both reflective and impulsive subjects by differentially reinforcing either long or short latencies. It was found that impulsive subjects reinforced for increasing their latency of response showed similar increased on post-treatment tasks. Reflectives reinforced for faster responding increased their speed. It was more difficult and less effective to bring this change about in reflective subjects, presumably because their prior experiences with such tasks had indicated the success of their former strategies. Despite the apparent success in modifying response latencies through differential reinforcement or delay, in none of the studies cited did the expected increase in accuracy occur, nor was there any generalization effect to other structurally similar tasks.

It has been demonstrated that the R-I dimension is relatively stable over time, thus indicating a lengthy reinforcement history. It seems highly improbable, in retrospect, that an enduring trait would be

significantly altered by having a child withhold his response for a period of time or by reinforcing slower responding over a few trials. It seems more likely that, given the demand characteristics of the situation, children simply complied with the experimenter and withheld responding for a period of time. This does not necessarily mean that the extra time was spent in a more thorough search of the visual array. In view of this, it is not a sufficient condition in modifying the accuracy scores of impulsive subjects.

Modeling

A more elaborate method of modifying the impulsive response is to expose impulsive children to the problem-solving behavior of reflective models. Debus (1970) placed third grade subjects in one of four modeling conditions where sixth grade students acted as models: (1) an impulsive model; (2) a reflective model; (3) a change model who began by responding impulsively and finished by responding reflectively; and (4) dual models, a reflective one and an impulsive one. It was found that in an immediate posttest condition, girls who had observed the reflective, change and dual models significantly increased their latency scores. Only the reflective model had an effect in changing the latency scores of boys. Debus unfortunately designed his study such that the reflective performance of the models was reinforced through praise, while the impulsive models received no reward. Thus, the effects of the various models upon changes in response time might simply be due to differential reinforcement patterns. Finally, error scores were not effected by any of the experimental treatments.

Yando and Kagan (1968) sought to determine whether changes in

conceptual tempo might occur in a natural setting (classroom). Over the course of a school year, impulsive and reflective children were exposed to teachers who themselves had previously been assessed as being impulsive or reflective. It was found that at the end of the school year impulsive boys who had exposure to experienced reflective teachers showed the most significant change. These changes, which the authors attributed to the modeling effect, again were relegated to shifts in response latency. Error scores remained unchanged. Similar findings have been reported recently by a number of investigators (e.g., Denney, 1972; Meichenbaum & Goodman, 1971; Meichenbaum, 1971).

Scanning strategies

The majority of studies reviewed to this point have demonstrated the difficulty of modifying error rates on match-to-sample types of tasks. It is possible, however, that the emphasis of these studies (at least implicitly) was upon changing tempo scores and that the planning of more efficient task strategies might have the effect of modifying error scores. In order to do this it is important to examine some of the variables comprising the microstructure of the R-I dimension. The question might be phrased in this way: "What is it that accurate, reflective children do, on match-to-sample tasks, that inaccurate, impulsive children do not do?" One potentially fruitful means of approaching this problem is to infer information processing strategies from characteristic visual scanning patterns of reflective and impulsive children: "Do individual differences exist in the methods by which children scan a visual array?"

An earlier study (Kagan, 1965) used head movements as gross indicators

of eye-movement patterns in an attempt to detect strategy differences between reflective and impulsive children. Two findings are of interest here:

1. The first is that all children exhibited an almost constant glance length at the standard of about 3 seconds, an invariance suggesting to the author some form of biorhythm;
2. Secondly, there was a high correlation between the number of head/eye fixations to the standard and response time. Kagan interpreted this finding as indicating that reflective children were actively dealing with information during their longer preresponse interval.

Using a mechanized version of the MFF which allowed for the recording of the amounts of time spent attending to the standard and to each variant, Siegelman (1969) demonstrated that it is not the absolute number of fixations to the standard that is crucial in determining attention deployment strategies. Rather, it is the percentage of time or looks devoted to the standard. Siegelman's major findings indicated that:

1. Reflectives devote proportionately less time as well as less frequent looks at the standard to the most observed alternative and to the variant finally chosen;
2. Reflectives took slightly but significantly more time per look than impulsives;
3. Impulsives ignored two-and-one-half times as many alternatives per item.

Due to the lack of extensive scanning and greater inequality of attention deployment of impulsive subjects, they may operate upon

impoverished input, causing the first plausible alternative to become the preferred candidate for response. An alternative explanation has been offered by Weiner and Berzonsky (1975) to the effect that performance differences might be due to the fact that impulsive children tend to deploy their adequate attentional processes upon less relevant aspects of the task. Using Hagan's (1972) incidental learning task, these researchers demonstrated how sixth grade reflectives focused upon more central aspects, while impulsives learned more of the peripheral aspects of the task. Results were interpreted in terms of Hagen's (1972) two-stage model of selective attention. The first stage involves identification of relevant and incidental cues. The suggestion is that impulsive children may have trouble attending selectively due to a lesser ability to sort out the central from the peripheral aspects of the task.[1]

It seems, then, that fundamental differences exist in the scanning strategies employed by reflective and impulsive subjects. And it is not simply a matter of reflectives taking longer but doing the same basic things. As Siegelman (1969) has demonstrated, reflective children seem to differentiate the properties of the visual array by comparing alternatives and consulting the standard for confirmation, selection or elimination. Impulsive children, on the other hand, seem to compare each variant globally with the standard, one at a time. The task for impulsives thus involves a series of binary decisions, each posing the

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[1]This line of speculation will not be dealt with further here other than to note that it creates a host of research questions in that it presents the possibility of a bridge between the R-I dimension and such other cognitive style dimensions as Field Dependence-Independence (see Douglas, 1972; Campbell & Douglas, 1972). One might also consider it in relation to the Piagetian concept of Decentration (see Elkind et al., 1965; Elkind, 1969).

question of sameness or difference. When no difference is found, sameness is inferred.

These findings are in general agreement with those of Drake (1970), Nelson (1968), and Goodman (1974). Drake (1970), for example, recorded the eye fixations of children performing the Matching Familiar Figures Test (MFF). Drake in effect recorded two bodies of data. The first accrued from recordings of the initial 6 seconds of each exposure to the stimulus item. The second was a record of the total performance to the first choice. During the first 6 seconds, reflectives spent a longer proportion of their time regarding the standard. In addition, they more effectively scanned the visual array.

A point of disagreement between Siegelman's (1969) and Drake's (1970) research presents an interesting empirical problem. In Siegelman's study, impulsive subjects looked at significantly fewer variants than did reflective subjects. Drake did not find this. The former study, however, presented subjects with six variants, while the latter had only four. In both studies impulsives scanned just over three variants. In the Siegelman study, reflectives on the average scanned five of six variants. If the impulsive child simply scans the array for a variant that globally resembles the standard with little fine discrimination involved, he may not need to peruse more than a few variants. With such low standards for comparison, he may quickly find a variant in which he sees no difference. Beyond a certain minimum, then, the number of alternatives may be of little consequence to the impulsive child. An interesting test of this hypothesis would be to array the variants in order of difficulty (i.e., ease or difficulty of discrimination) and

to make predictions about which point in the array impulsive subjects will make a mistake. This suggestion also has implications for the modification of the impulsive cognitive tempo which will be dealt with as we proceed.

<u>To reiterate</u>

Studies have indicated basic differences in the information processing strategies of Reflective and Impulsive children. These strategies are inferred from eye-scan data. The impulsive child does not seem to pause and consider possible alternative methods of approaching the data. He accepts as correct any variant for which, during a brief period of scanning, he found no deviation from the standard, regardless of whether or not other variants, similarly scanned, looked equally the same. Drake (1970) suggests that impulsive children do not feel a great need to scan all variants before choosing. This suggestion is in general agreement with two of three possible explanations for the antecedents of the R-I advanced by Kagan (1966a), i.e., competency may be seen from the viewpoint of either speed or accuracy since both are highly regarded in this society, or that impulsives are not made anxious by the possibility of error.

Reflectives, in contrast to Impulsives, seem to recode task instructions into one of two or both of the following rules:

1. Look for differences between variants and standard and choose a variant only if a difference is not found;
2. Look for differences between variants and standard and eliminate deviant variants until only one remains.

The remaining variant must be the same as the standard. Reflectives began the task by spending a disproportinately large amount of time on the standard as though they were fixing the standard's features as a source of feedback. Attention was then shifted to the variants.

In a recent series of studies (Zelniker, Jeffrey, Ault, & Parsons, 1972; Ault, Crawford, & Jeffrey, 1972; Ault, 1973), eye-scan data were recorded along four major parameters:

1. Mean number of fixations per trial;
2. Fixation duration (i.e., total time to the first response divided by the number of fixations for four trials);
3. Proportion of fixations on the standard (i.e., number of fixations on the standard divided by the total number of fixations);
4. Mean number of variants fixated at least once during a trial (to a maximum of six).

Zelniker _et al_. (1972) found that reflective and impulsive children differed on only two of the above parameters. Reflectives, it was found, had more fixations and scanned more variants. Two scanning strategies were described reflecting differing levels of sophistication. These were: (1) _Returns_, which meant paired comparisons, and (2) _Runs_, which were serial comparisons of successive fixations on at least three separate, contiguous variants. It was found that neither Reflectives nor Impulsives indulged frequently in the more sophisticated "Run" strategy. Zelniker _et al_. concluded that Reflectives and Impulsives did not differ in basic scanning strategies and, "given that reflective subjects spend more time at the task than impulsive subjects, the greater mean number of fixations appear to be direct correlates of the time S observes the card (p. 332)".

Essentially, then, there are two bodies of eye-scan data which to a certain extent are in opposition: One indicates that reflectives and impulsives use the same basic strategies but reflectives take more time and presumably deal with more information; the other indicates that the strategies used by the two groups are fundamentally different.

Since, according to their data, impulsives use the same strategies as reflectives but do not deal with enough of the visual array prior to selecting a variant, Zelniker _et al_. (1972) reasoned that to improve the performance of impulsive subjects it would be necessary to have them consider all possibilities before responding. In order to facilitate this, the Discriminating Familiar Figures Test (DFF) was devised. On this task all variants but one were identical to the standard. The problem was thus to find the one that differed. It was found that by varying the basic MFF format in this way, impulsive task strategies were altered due to the fact that on this task it was less essential to compare each variant to the standard since each variant, once identified as not different from the standard, could act as a substitute for it. In addition, since only one variant differed, the array was thoroughly scanned until the deviant feature was identified. Not only did impulsive performance improve on the DFF, but the effect generalized to performance on an alternate form of the MFF on which impulsive children demonstrated a higher level of accuracy without a corresponding decline in speed.

The simplicity and obvious utility of this intervention technique is immediately apparent. A second look at the Zelniker _et al_. data, however, raises some question as to the efficacy of the results.

As may be seen from Figure 1, the mean number of errors committed

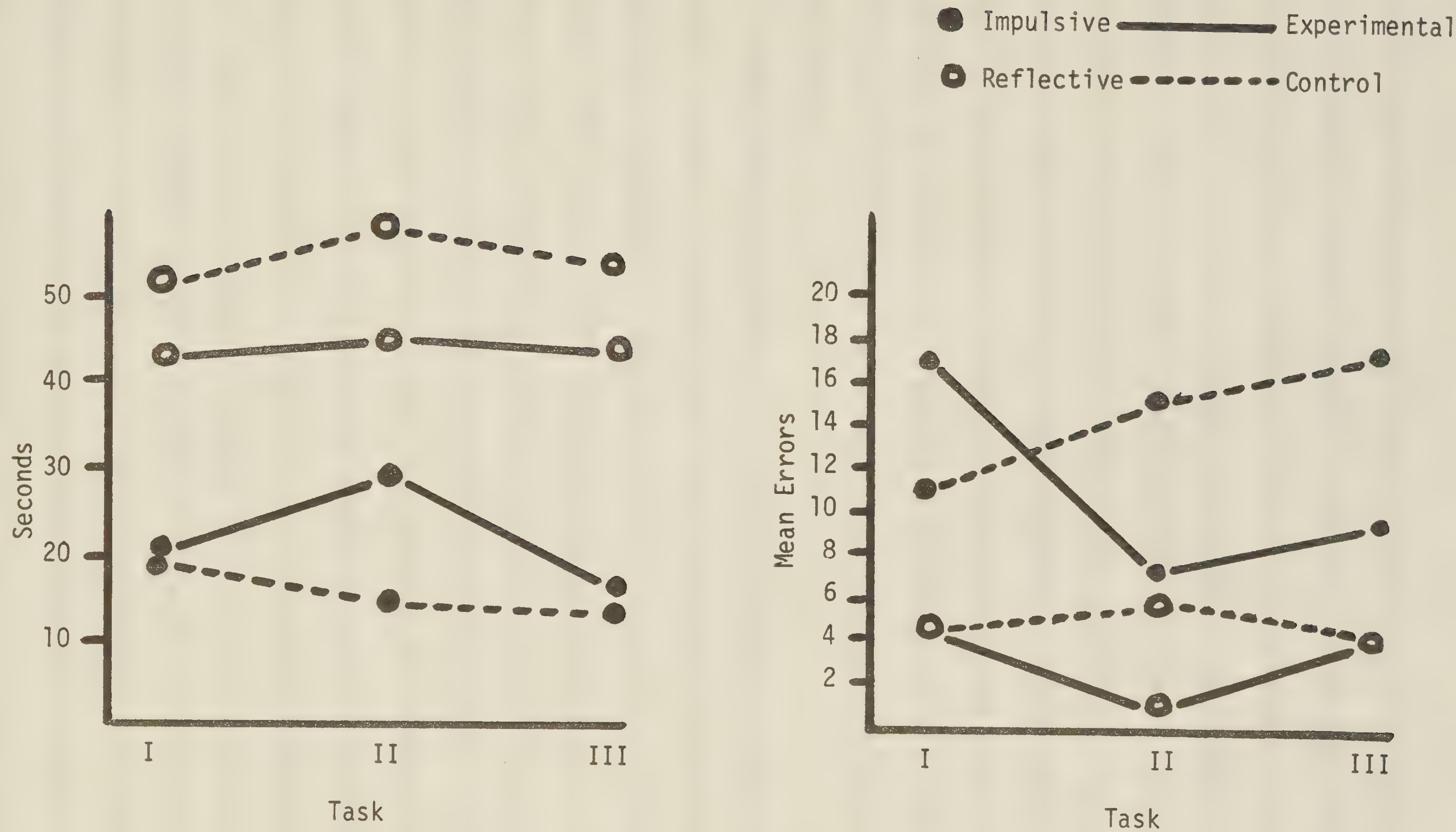

Fig. 1. Mean error scores and response latency scores in seconds of the four groups on each task

by the experimental impulsive group was considerably higher than that of the impulsive control group. In addition, while the performance of the experimental group improved following the treatment condition, the performance of the control group (which simply did another MFF series) declined. The significant findings would thus seem to be a result of the joint effect of declining control group performance and regression toward the mean on the part of the experimental group which on the pretest had committed an average of 25 per cent more errors than their controls. In view of this apparent discrepancy and since the remedial technique is potentially valuable, it would be well worthwhile to re-do this study.

Based upon such findings as those of Siegelman (1969) and Drake (1970), a number of recent studies have introduced the teaching of heuristic techniques for dealing with information (e.g., Meichenbaum & Goodman, 1971; Debus, 1970; Ridberg, Parke, & Hetherington, 1971; Egeland, 1974). These studies have indicated varying degrees of success in modifying the strategies of impulsive subjects in such a way that accuracy of performance improves. Meichenbaum and Goodman (1971), by having impulsive children instruct themselves, were able to effect a reduction in speed and an increase in the accuracy of performance. The "cognitive self-guidance" program devised by these researchers is based upon Vygotsky's (1962) suggestion that the internalization of verbal commands is a critical feature in the development of self-control. Children were given a list of task-related rules to verbalize aloud. Later, as the children became more proficient, the overt verbalizations were faded out on the assumption that the child's covert or inner speech

would assume a regulatory role. Both Debus (1970) and Ridberg, Parke, and Hetherington (1971) used brief modeling techniques in their attempts to modify the task strategies of reflective and impulsive children. As mentioned earlier, the experimental conditions in the Debus study were confounded, making it impossible to discern the important aspects of the experimental procedures. Ridberg et al. (1971) incorporated more rigorous control conditions into their study than did Debus (1970). Results indicated that their modeling techniques were successful in improving the accuracy of impulsive subjects. Analysis of these results, however, indicates that the individual variation was so high within each treatment group that one can only conclude that, while the intervention techniques improved the performance of some subjects, they had debilitating effects upon others. It would be of interest to discover the efficacy of this conclusion.

Although limited in scope, the foregoing review of the literature bearing upon the cognitive tempo dimension of Reflection-Impulsivity has indicated the pervasiveness of cognitive impulsivity throughout a wide variety of problem-solving situations. Of particular concern for the present reviewer is the possibility that the impulsive response might underlie many educational problems faced by school children, particularly in such areas as reading and mathematics. Research bearing upon this issue, though inconclusive, does suggest the need for further exploration.

The foregoing review of research bearing upon the cognitive tempo dimension of Reflection-Impulsivity has, of necessity, been selective. Thus, to a certain extent it is limited. Studies have illustrated, nevertheless, that cognitive impulsivity does affect performance in a

large number of instances. Few of the areas reviewed have consistently demonstrated the pervasive qualities of the R-I dimension. However, enough evidence has accumulated to warrant a great deal of further research. It is not at all clear, for example, how such variables as intelligence, sex, race or socioeconomic status are related to the R-I dimension, or to one another for that matter. Nor is it possible yet to state with any assurance the underlying causes of cognitive tempo. Is it a reflection of anxiety, the lack of anxiety, different sources of anxiety, a predisposition, or modes of information processing? Or could it reflect a number of different antecedents?

One thing seems sure amidst the apparent confusion; when one weighs the evidence, indications are that impulsive children perform more poorly on a host of educational or school-related tasks. Specifically it has been demonstrated that impulsive children do more poorly than reflective children at reading, arithmetic, general achievement, inductive reasoning and other forms of problem solving. And special educators have recently expressed concern over these findings (e.g., Epstein, Hallahan, & Kauffman, 1975; Hallahan, 1975; Keogh, 1973). Keogh (1973) has, in fact, provided a basis for the inclusion of cognitive impulsivity within the mainstream of Learning Disabilities, one suggestion being that it is related to behavioral impulsivity or hyperkinesis.

In view of the possibility that cognitively impulsive children might suffer academically, it would be of great benefit were a practical technique devised by which the cognitive tempo of these children might be altered. A growing number of projects have been directed toward this end. A few of these have been successful (e.g., Egeland, 1974; Meichenbaum

& Goodman, 1971). The majority have not.

The present research is addressed primarily to the proposition that the quality of visual information can be improved through modification of idiosyncratic task strategies. More specifically, two methods were developed in an effort to improve the performance of youngsters on tasks which require fine discriminations among closely matched stimulus items (e.g., such match-to-sample tasks as the MFF). It has been suggested that "impulsive" children perform more poorly in various aspects of reading. It is of interest, then, to raise the empirical question: "Will improved scores on a match-to-sample test be accompanied by improved performance on a test of reading?" Or put another way: "Do strategies used in reading and MFF performance have common properties?"

Though of lesser interest in the present research, a number of variables have been subjected to a "pretest" correlational analysis. These have been included in an effort to shed some light upon the following questions crucial to R-I research:

1. Do males and females perform differently with respect to the R-I dimension?
2. Are intellectual factors implicated in measures of reflection-impulsivity?
3. Is there a relationship between R-I scores and reading?
4. Is "cognitive impulsivity" related to behavioral impulsivity or hyperkinesis?

CHAPTER III

METHOD

The previous chapters selectively reviewed the literature relating to cognitive tempo and outlined the objectives of the present research. In this chapter the focus is upon the research design and the children who participated as subjects.

A number of questions of both practical and theoretical interest prompted the present research. The primary focus, however, was directed toward developing a viable technique by which certain problem-solving strategies of impulsive (i.e., fast and inaccurate) youngsters could be modified such that their levels of accuracy might improve. To this end, two techniques were developed and tested. Each of these is the basis for a separate study and each study is described here in detail, including all materials used, training procedures, and posttest data collection.

Design - Study I

The design of this study was a 2 x 3 factorial having two levels of sex as the first factor and three levels of treatment as the second. Treatment levels included a Television Modeling (TM) group, a Materials Only (M)) group, and a Control (CG) group.

There were three dependent measures in the present study: (1) latency scores on the Matching Familiar Figures Test (MFF); (2) accuracy scores on the MFF; and (3) accuracy scores on the Gates-McKillop Words subtest. Testing on the dependent variables required a pretest (PT) session prior

to training and a posttest (PA) session administered three days after training had concluded.

In addition, all subjects in the pretest condition were administered the Raven's (Coloured) Progressive Matrices Test and data were collected from student files regarding Lorge-Thorndike IQ scores. Teachers were requested to complete a form of David's (1971) Hyperkinesis Scale for each child in the sample.

During the training situation, the TM group was shown a videotaped presentation of a 13-year-old male model describing to the experimenter the strategies behind his successful MFF performance. Following his description, children in this group were presented with practice booklets containing match-to-sample problems consisting of complex geometric figures. The children were encouraged to do the problems in a manner similar to that of the model. Each practice booklet had ten problems and took about 20 minutes to complete. In addition to the two modeling sessions, each TM subject received an additional practice session. Approximately three days elapsed between each practice session and the total amount of time taken by the training procedures was between 60 and 90 minutes per subject.

Subjects in the MO condition were presented in each of the three sessions with a practice booklet identical to the ones used by the TM group. MO subjects were required to complete these without having viewed the televised model.

All three groups were then retested using alternate forms of the Matching Familiar Figures Test and the Gates-McKillop Words subtest. Table 1 presents the design of Study I.

Table 1

Experimental Design of Study I

Pretest (PT)	Classify	Randomize Subjects	Train	Posttest (AT)
Administer MFF, Gates-McKillop, and Raven's (Coloured) Progressive Matrices to all subjects	Select impulsive subjects on the basis of a Double Median Split of MFF speed and error scores	Male - TM	x	x
		Male - MO	x	x
		Male - CG		x
		Female - TM	x	x
		Female - MO	x	x
		Female - CG		x

Design - Study II

Study II was a partial replication of one conducted by Zelniker, Jeffrey, Ault, and Parsons (1972). The 2 x 2 factorial design of the present study included two levels of sex and two treatment levels. The dependent variables were the same as those in Study I. Treatment levels included a discriminating figures (DFF) group and a control (CG) group.

The Discriminating Figures Test devised by Zelniker _et al_. (1972) has a similar format to that of the MFF, with the provision that, instead of only one variant being identical to the standard, the DFF has only one variant which differs from the standard and subjects must identify this one. Subjects in the DFF condition were required to participate in one session during which the 12-item DFF was presented to them.

Control subjects, as in the Zelniker _et al_. (1972) study, were given a practice session using an alternative version of the MFF.

All subjects were then retested using forms B of the MFF and Gates-McKillop Words subtest. Table 2 presents the design of Study II.

Table 2

Experimental Design of Study II

Pretest (PT)	Classify	Randomize Subjects	Train	Posttest (AT)
Administer MFF, Gates-McKillop, and Raven's (Coloured) Progressive Matrices to all subjects	Select impulsive subjects on the basis of a Double Median Split of MFF speed and error scores	Male - DFF	x	x
		Male - CG		x
		Female - DFF	x	x
		Female - CG		x

Subjects

Two hundred and two fourth grade children took part in Study I. Of these, 99 were male and 103 were female. Ages ranged from 110 to 122 months, with a mean age of 116.2 and a standard deviation of 3.4 months.

The three Edmonton Separate Schools from which the sample was drawn were located in close proximity to one another in an area of predominantly clerical and blue collar families.

Forty-seven male and 47 female grade four students were subjects in Study II. These ranged in age from 110 to 122 months, with a mean age and standard deviation of 116.6 and 3.1 respectively. All children in Study II attended Braemar School in the Edmonton Public School System. Socioeconomically, families in this school area fall in the lower-middle to middle-class range. Since no objective measure of socioeconomic status was performed, SES was not included as a variable in the present research.

Test Materials

Tests used in the present research are briefly described below along with the general rationale for their selection. More detailed descriptions may be found in the appropriate references.

Matching Familiar Figures Test (MFF)

The MFF developed by Kagan and his associates (Kagan *et al.*, 1964) is the most widely used match-to-sample test in cognitive-tempo research. Its use in the present research allows, then, for comparison with the mainstream of research in the area. In addition, by definition the impulsive youngster is one who responds quickly and inaccurately in situations presenting a high degree of response uncertainty. Kagan (1965c) indicates that the MFF is the test providing the highest degree of response conflict.

This instrument is composed of 12 test cards and two practice items, each of which consists of line drawings of familiar objects (e.g., ship, teddy bear, cowboy). Subjects are shown a picture of the familiar object (the standard) and six alternatives (variants), only one of which is identical to the standard. The task is to choose the variant which is identical to the standard. A careful visual search is required for a high performance level on this test, since all of the alternatives vary only slightly from the standard figure.

Scoring is based upon the time taken to make an initial response to each stimulus card and the total number of errors on the test. When a child commits an error, he is told to "find the one that is just like the other". If more than six errors occur on any one item, the child is

given the correct answer and the next item is presented. Examples of the MFF and complete instructions may be found in Appendix I.

There are two forms of the MFF which are highly correlated on both speed and accuracy (Kagan & Kogan, 1970). Form B was used as a post-treatment measure to reduce the possible practice effect due to using Form A on both occasions.

Canadian Lorge-Thorndike Intelligence Tests

The Lorge-Thorndike is a group-administered, paper-and-pencil intelligence test which receives wide use in Canadian school systems. The Edmonton school boards administer the test to each child every two years. Thus, children who took part in the present research had been administered the Lorge-Thorndike during the present school year. Results of this testing were acquired from student records.

Although Kagan has on a number of occasions (e.g., Kagan & Kogan, 1970) indicated that MFF scores are relatively orthogonal to measures of verbal intelligence, an extensive study by Eska and Black (1971) demonstrated that the cautious researcher should not accept the Kagan assertion uncritically. A number of studies reviewed by these researchers (e.g., Meichenbaum & Goodman, 1969) found that impulsive subjects tended to score lower than other children on paper-and-pencil IQ tests.

The use of the Lorge-Thorndike in the present study serves two main purposes: first, it allows for an independent check on the relationship between the R-I dimension and IQ as measured by this type of instrument; secondly, it allows the researcher to control for extremes in the experimental sample.

Raven's (Coloured) Progressive Matrices (RCPM)

The RCPM, the format of which in some ways matches that of the MFF, is regarded as a nonverbal test of general intelligence. Subjects are shown a series of six-celled matrices conveying various concepts. Only five of the cells in each matrix are filled, however, and the problem is to choose from anong six alternatives the one which correctly completes the concept. There are a number of levels of this test, each varying in difficulty. While the more advanced levels are largely cognitive tasks, "reasoning by analogy as a consistent method of inference" is tested in only two designs in the RCPM (Guide to using the Coloured Progressive Matrices, p. 4). While establishing the part-whole relationship is no doubt a feature of successful performance on this test, another important aspect is accurate search of a complex visual array.

Thus, one might intuitively predict a strong relationship between MFF and RCPM scores. Research findings on this point, however, have been equivocal (e.g., Reznik, 1975; Gupta, 1970).

The test has been included here in the hope that its relation to the R-I dimension will become clearer.

The Gates-McKillop Reading Diagnostic Tests: Words subtest (Forms A and B)

The Words subtest of the Gates-McKillop has been included here as a measure of reading accuracy. Research findings with regard to the relationship of reading to the R-I dimension are ambiguous (e.g., Lubus, 1974; King, 1972). One feasible explanation for the poor performance of "impulsive" children on match-to-sample tasks is that they have learned poor strategies for dealing with complex visual problems.

One aspect of reading involves making sense of a highly complex visual array, a feature one might expect to be debilitating to the impulsive subject's performance.

David's Hyperkinesis Scale

Recently a number of studies have attempted to link cognitive-tempo research with the more general area of learning disabilities. Specifically, attempts have been made to relate cognitive impulsivity to the hyperkinetic syndrome (Keogh & Donlon, 1972; Campbell, 1973).

A number of traits or behaviors have been isolated by clinicians as being associated with hyperactivity. David's (1971) scale includes seven of these, with appropriate explanations. The rater assigns a value of between 1 and 6 to each trait, 1 indicating a low rate of occurrence for the specific type of behavior and 6 indicating a high rate. Behaviors include hyperactivity, impulsiveness, irritability, etc. A total score for all seven items is assigned with a maximum score of 42.

An association between cognitive impulsivity and the construct "behavioral impulsivity" is potentially a fruitful one, having implications both practical, with regard to the area of learning disabilities, and theoretical, with regard to the efficacy of the R-I construct.

Procedure

Pretest

The initial phase of the present research had a two-fold purpose: (1) to obtain data for the general correlational analysis, and (2) to obtain a sample of "impulsive" children to participate in

phase two.

Testing required two sessions. During the first session, each child was individually administered the Matching Familiar Figures Test (Form A) and the Gates-McKillop Words subtest (Form A). In session two, all subjects completed Raven's (Coloured) Progressive Matrices.

To obtain a sample of children who were both fast and inaccurate (i.e., impulsive), scores on the MFF were divided at the medians for both speed and accuracy. Although the initial phases of Studies I and II were identical, the data, as mentioned earlier, were treated as being discrete. Table 3 presents the results of the double median split on MFF scores.

Table 3

Median Scores for MFF Time and Errors

Study	Grade	N	MFF Time (Average)	MFF Errors (Total)
I	4	202	12 seconds	10
II	4	94	12 seconds	10

Children whose MFF scores fell below the median latency and above the median for accuracy were defined as impulsive. Of the 202 subjects in Study I, 72 fell into the impulsive category. Of these, 36 were male and 36 were female. Thirty-three subjects in Study II were operationally defined as impulsive. Seventeen of these were male and 16 were female. In order that experimental groups could be of equal size, one male subject was randomly omitted from further participation.

Subjects in Study I were then randomly assigned to one of the

three experimental conditions (TM, MO or CG), while subjects in Study II were assigned to either the Discriminating Familiar Figures (DFF) group or to the Control (CG) group. One limitation was imposed upon these subdivisions in that equal numbers of males and females were placed in each subgroup.

Training

Study I (Televised model group). Each subject in this condition was brought individually to the workroom during training session one. Here he/she was re-acquainted with the experimenter and told that they would be meeting there on several occasions to do some exercises similar to those performed a few days earlier. To enhance recall, each subject was then presented with two MFF stimulus items after which he/she was told that they were going to see a boy perform the same test on television.

The following is a description of the main points presented in the training film:

1. The film begins with the model performing the MFF test in the standard way.
2. After three trials, during which only one error is committed, the experimenter comments favorably upon the model's accurate performance and inquires how he goes about doing the test.
3. The model's explanation is based upon a number of rules abstracted from the visual scanning data reported by Siegelman (1969) and Drake (1970). These are: (a) take time to become familiar with the standard; (b) scan the array for distinctive features that differ between the variants; (c) check the standard for the correct form

of the critical feature; (d) eliminate variants having deviant features; (e) combine a series of similar cycles until all variants but one have been eliminated.

4. These rules are operationalized by the model as follows: "First I take a good look at this one (model points to standard). Then I look at one part of the picture (points to a feature of the standard) and look to see if the others are all the same (checks same feature on other variants). If any are different, I don't have to look at them any more. Then I take another part of this one (points to another feature of the standard) and look to see if any of the others are different." The model continues this procedure until all but one variant have been eliminated and this he infers to be the correct one.

Following a number of such trials, the film ended and the subject was given a booklet in which were ten complex geometric line drawings arranged in a format similar to that of the MFF. These they were asked to complete "just like the boy in the film".

Three days later TM subjects were once again shown the film and then were given another set of ten geometric problems for practice.

On a third occasion subjects in this group were presented with yet another practice booklet but this time were not shown the film.

Study I (Materials only). The training procedure for the MO group was much the same as that followed by the TM group. While the MO group subjects were not shown the televised presentations, the practice booklets given to them were identical to those used by the TM group. Examples of practice materials can be found in Appendix B.

Study II (Discriminating Familiar Figures). During the DFF training session, subjects were presented with booklets containing 12 items based upon the Discriminating Familiar Figures Test (Zelniker, Jeffrey, Ault, & Parsons, 1972). These figures, though similar in format to those of the MFF, required subjects to find the variant that was different from the standard. Briefly, the rationale behind this procedure was the following: While performing an item on the MFF, one must scan the array for one variant that is identical to the standard. Impulsive subjects, who tend to be brief in their perusal of the stimulus, identify as "same" the first variant in which they see no difference from the standard. Reflective subjects, on the other hand, withhold their decision until all variants have been viewed. Thus, reflectives are less likely to commit errors. The DFF test, unlike the MFF, forces the subject to look for the one feature in the array which differs from the standard. Thus, impulsive subjects, in a manner similar to that of their reflective counterparts, must employ a more thorough search of the visual array. Zelniker et al. (1972) reasoned that strategies learned by impulsive subjects on the DFF would generalize to MFF performance.

At the beginning of the DFF training session, subjects were told that they were going to do an exercise something like the one they had done previously. Two MFF items were shown to refresh their memory. The experimenter then told the subject that the only difference was that he/she had to find the picture that was different from the one above (i.e., the standard). The session continued thus for all 12 items of the DFF.

Posttest

In order to assess the effectiveness of training on the various experimental groups, a second form of the MFF was administered to these groups and then controls approximately three days after the training sessions ended. In addition, an alternate form of the Gates-McKillop Words subtest was administered to assess possible generalization effects of training.

It should be noted that the control group in Study I was administered the MFF and Words subtest prior to and following the training sessions. In Study II control subjects were administered a third version of the MFF, while the experimental group performed the DFF. The procedure followed in Study II was intended to make results more directly comparable to those of the Zelniker, Jeffrey, Ault, and Parsons (1972) study.

CHAPTER IV

RESULTS AND DISCUSSION

Study I

Description of sample

Table 4 presents the means and standard deviations of age and test scores from session one. It might be noted that the average Lorge-Thorndike (107.1) and Raven's Matrices (29.6) scores are somewhat higher than the expected means of 100 and 24 respectively. As has been demonstrated before, this is not an uncommon finding in the Edmonton area (Souch, 1970) and possibly reflects the relative affluence (or lack of poverty) in this part of the country. Though not significantly greater than predicted scores, the above results emphasize the real need for local normative data regarding IQ and achievement test performance.

Table 4

Means and Standard Deviations
of Variables and Tests
Administered in Session 1 of Study I

Variable	Mean	SD
Age (months)	116.2	3.30
MFF latency	13.4	8.20
MFF accuracy	9.0	5.40
Words reading	69.2	8.20
Lorge-Thorndike (full scale)	107.1	11.70
Raven's (accuracy score)	29.6	4.60
Hyperkinesis	16.7	8.15

MFF Latency (13.4) and Accuracy (9.0) scores obtained in the present study are compatible with others in the literature (e.g., Briggs & Weinberg, 1973). That is not to say, however, that unanimous agreement exists as to whether or not a subject will fall within the Impulsive category. There are, in fact, large discrepancies from one study to another with regard to which subjects are classified as Impulsive and those assigned to the Reflective category. Compare, for example, the impulsive subjects of Ridberg, Parke, and Hetherington (1971) - Latency = 8.94 seconds, Accuracy = 8.42 errors - with those of Zelniker _et al_. (1972) - Latency = 17.4, Accuracy = 14.0. In short, impulsive subjects in the former study, though considerably faster than those in the latter, were nevertheless much more accurate. Results like these illustrate one of the major weaknesses of MFF research, the lack of normative data. Since the MFF categorizes subjects on the basis of performance relative to a given sample, no norms have been collected, with the result that it is conceivable that the Impulsive subject in Study A could very well be the Reflective subject in Study B.[1]

The mean Word Recognition score (69.2) in the present study suggests that children in this sample are performing at a level approximately three-quarters of one grade score higher than the expected norm. It is tempting to immediately relate this finding to the slightly higher-than-average Lorge-Thorndike results. There does, however, seem to be a more likely conclusion relating higher Word Recognition and pronunciation skills to increased emphasis upon

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[1]Since the present research was completed, progress has been made toward remedying the above situation (Egeland & Weinberg, 1976).

phonics in the teaching of reading.

Finally, David's (1971) Rating Scale for Hyperkinesis is primarily a research instrument with no comprehensive normative data. The author, however, suggests that a score of 17 is about average. The mean score (16.7) of the present sample is compatible with this suggestion.

Pretraining measures

In the present study it was not possible to obtain separate "verbal" and "nonverbal" subtest scores from Lorge-Thorndike results. Thus, only "full scale" scores are reported. A correlational matrix was computed for the eight pretraining variables (age, sex, MFF Latency, MFF Accuracy, Word Reading, Lorge-Thorndike, Raven's Matrices, and Hyperkinesis). Table 5 presents the resulting coefficients.

Age differences were not expected to be of great significance due to the restricted age range. And it may be seen at a glance that this indeed was the case.

The only significant finding with respect to the sex variable was the relationship of subject gender to teacher ratings of Hyperkinesis ($r = -.31$; $\underline{p} < .01$). Teachers tend to rate boys higher than girls in terms of manifest hyperactive behavior, and this is no isolated finding. As noted by Douglas (1972), hyperactivity is so much more in evidence among boys that speculation has been raised regarding the possibility of a sex-linked or sex-influenced characteristic. In view of recent findings, however, there is a tendency to view the hyperkinetic syndrome as largely a socially-defined phenomenon (Kaspar et al., 1971; Douglas, 1972; Tarver & Hallahan, 1974).

In the present study, hyperactivity was defined operationally as

Table 5

Intercorrelations of Pretraining Measures
in Study I

	1	2	3	4	5	6	7	8
1. Age		.048	-.028	-.101	.045	.006	-.023	-.061
2. Sex			.105	-.085	.022	.029	.025	-.311
3. MFF latency				-.301	.154	.077	-.076	-.200
4. MFF accuracy					-.225	-.210	-.129	.197
5. Word reading						.475	.123	-.164
6. Lorge-Thorndike							.501	-.258
7. Raven's Matrices								-.184
8. Hyperkinesis								

p .05; *r* = .195
p .01; *r* = .254
df = 200

the total score on David's (1971) Hyperkinesis rating scale. This method was suggested by the author and is supported by results from a recent factor analytic study of the scale (Lawson, 1976). Only a single factor emerged from this analysis. It would be of interest, nevertheless, to determine which, if any, of the scale's seven characteristics are reliably predicted from gender of subject.

If hyperactivity can, in fact, be traced to specific interactions among situational variables and sex of subject, these would provide important directional clues with respect to remedial planning.

No sex differences were found in the present study with respect to either MFF Latency or Accuracy. These results, though congruent with others in the literature (e.g., Reznik, 1975; Garner, Percy, & Lawson, 1971), do not find unanimous support either (e.g., Cathcart & Leidke, 1971). And Kagan and Kogan (1970) have suggested that differences between pairs of variables might not be as important as patterns of differences among groups of variables. With this admonition in mind, it was decided to include the sex variable within the experimental design of this study.

A large number of studies in the MFF literature have indicated that speed and accuracy are negatively correlated for performance of match-to-sample tasks. That is, children who respond most quickly on this type of task usually make the most errors, etc. The significant correlation found in the present study ($r = -.30$; $p < .01$) is congruent with the majority of investigations (e.g., Kagan, 1964, 1965; Yando & Kagan, 1968; Eska & Black, 1971). As noted by Reznik (1975), however, a significant correlation does not by any means imply causality. With respect to MFF research, this fact can be demonstrated in at least two ways:

1. If, in fact, speed caused inaccuracy, then logically one might predict an increase in accuracy as a consequence of a decrease in the speed of response. This prediction has not withstood the experimental test (Briggs & Weinberg, 1973; Alason, 1969).
2. The double median split procedure used to categorize MFF performance defines four groups. One of these includes a small group of children who are both fast and accurate; another describes a group both slow and inaccurate.

In addition, it should be noted that while the bulk of research findings has reported a significant negative correlation between Latency and Accuracy variables, the magnitudes of these correlations have varied from -.02 to -.69 (Eska & Black, 1971). There are many possible reasons for these widely fluctuating results. One of these relates to the proportion of fast/accurates and slow/inaccurates within a given sample population. It seems reasonable to presume that as long as no normative data are available for MFF performance, relative fluctuations of these two groups will exercise an effect upon the relationship between speed and accuracy measures.

MFF Latency scores were not related to Reading, Lorge-Thorndike scores or Raven's scores. It is unfortunate that it was not possible in the present study to obtain separate "Verbal and Nonverbal" Lorge subtest results. These were available in Study II, however, and demonstrated no significant relationships with MFF Latency scores. These findings are generally in support of the contention that measures of cognitive impulsivity and verbal intelligence are largely unrelated (Kagan & Kogan, 1970).

Once again, it should be emphasized that the present results do not find unanimous support in the literature with regard to the orthogonality of cognitive tempo variables and verbal IQ measures (Gupta, 1970; Souch, 1970; Eska & Black, 1971). In most of the studies where significant positive relationships have been obtained between MFF latency scores and IQ, it is of interest to note that the IQ test format was similar to that of the MFF (Reznik, 1975; Meichenbaum & Goodman, 1969). The similarity, then, of the Lorge-Thorndike format to that of the MFF renders the present results more poignant in that no significant correlation was found.

With regard to the Raven's test, Reznik (1975) found that impulsive subjects perform less well than do reflectives. The difference maintains, however, only with respect to accuracy scores. When latency of response is considered, no differences are found between these groups. In short, reflectives perform just as quickly yet more accurately than impulsives. The present study suggests that MFF response speed is not associated in any significant way with Raven's accuracy scores, thus suggesting that differences in Raven's scores are related to either MFF accuracy scores or to the interaction of MFF speed and accuracy. This suggestion is yet to be pursued.

In view of the insignificant relationships between MFF latency scores and Raven's Matrices and Lorge-Thorndike scores, it is not surprising that Word Reading and Latency are not significantly correlated. In theory, however, one might predict a relationship among all of these variables. Each of them, for example, might be regarded as a complex visual processing task on which choices must be

made among multiple alternatives. Implicit in MFF research is the assumption that speed reduces accuracy. And to a certain extent this seems to be the case. Thus, on tasks of a similar type, it might be expected that this formula would "bear up". This seems not to be the case or, to look at it a little more realistically, eye scan data have revealed that not only do impulsive subjects take less time to scan the visual array, but they also do so less efficiently. Thus, it might be predicted that on tasks requiring thorough scanning of a visual array, impulsive subjects would do less well. The nonsignificant relationships found in the present data do not suggest this to be the case and further suggests that MFF Latency is a state-specific variable.

As indicated in Table 5, there is a marginally significant correlation between MFF Latency and Hyperkinesis ($r = -.20$; $p < .05$). This finding is of interest when considered alongside MFF Accuracy and Hyperkinesis ($r = .20$; $p < .05$). Essentially, these results are taken to indicate that as the length of the latency period decreases, teachers' ratings of Hyperkinesis increase. In addition, as the number of MFF errors increases, so too do teachers' ratings of Hyperkinesis. In short, subjects who are faster and less accurate on the MFF are rated by teachers as exhibiting higher levels of hyperkinetic behavior. The possibility that cognitive impulsivity and behavioral impulsivity are related is extremely interesting and has a number of implications for special education. As such, it should be investigated further.

Perhaps it is time to consider the overall pattern of results in the present study in an effort to lend some coherence to the findings. Boys are more often seen as being more hyperactive than girls ($r = .31$;

p .01). Though MFF Latency and Accuracy scores are significantly and negatively correlated ($r = -.30$; $p < .01$), only accuracy is significantly related to Reading ($r = .25$; p .01) and to Lorge-Thorndike ($r = .21$; $p < .05$). These two latter variables are highly correlated ($r = .48$; $p < .001$). As might be expected, Raven's Matrices and Lorge-Thorndike are highly correlated ($r = .50$; $p < .001$) but, surprisingly, Raven's and Word Reading are not ($r = .123$; NS). Neither MFF Latency nor MFF Accuracy scores are significantly related to Hyperkinesis, although a strong trend is in evidence.

With respect to MFF scores, it would seem that speed is not a critical variable vis a vis Reading Accuracy or Lorge-Thorndike performance. Accuracy seems to be the key variable here and suggests that the more accurate is the score on the MFF or, to be more precise, the fewer errors made, the higher will be Reading and Lorge-Thorndike IQ scores. In view of this, one might speculate that accuracy takes up the bulk of the variance in relating MFF scores to measured intelligence. The suggestion that different weightings may be attributed to speed and accuracy variables is not pursued in the present research, but a clearer explication of this relationship might prove of great value in clarifying the relationship between reflection-impulsivity and intelligence (see Eska & Black, 1971).

Findings with regard to the Hyperkinesis variable are of particular interest here. Taken together, they indicate that the child who is fast and inaccurate on MFF, poorer in Reading and lower in measured IQ is also described by his teacher as more Hyperkinetic. These findings, however, are merely suggestive and it will require further research to

articulate them with any clarity.

Keogh (1971) has suggested that hyperactive children might be considered extreme examples of impulsive children, and Campbell (1973) has lent support to this suggestion, demonstrating that hyperactive and impulsive boys performed similarly on the MFF. In view of this, it seems even more pressing to explicate the above relationships since if, in fact, both behavior patterns are part of a single continuum, then clarifying the relationship among interacting variables for one might supply important dues to the etiology of the other.

Experimental session

From the data obtained in session one, a sample of "impulsive" subjects was selected to participate in the experimental study (N = 72). Of these, 24 subjects were randomly assigned to either the Materials Only (MO), Television Modeling (TM) or Control (CG) group. The only restriction in group assignment was that an equal number of girls be represented in each group.

A two-way analysis of variance was performed on the data to determine whether the treatment conditions had an effect upon performance and to determine whether treatment conditions had differential effects upon male and female subjects.

The design selected is referred to formally as a Posttest Only Control Group Design. This was selected over the usual "repeated measures" analysis for reasons noted by Campbell and Stanley (1963):

> While the pretest is a concept deeply embedded in the thinking of research workers in education and psychology, it is not actually essential to true experimental designs. For psychological reasons it is difficult to give up "knowing for sure" that the experimental and control groups were

> "equal" before the differential experimental treatment . . . Within the limits of confidence stated by the tests of significance, randomization can suffice without pretest. (p. 25)

The present experimenter, as suggested by Campbell and Stanley, could not entirely relinquish the feeling of "knowing for sure" that all groups were equal with respect to the dependent variables prior to treatment. Thus, a "pretest" analysis of data was conducted for each variable. Summaries of these are presented in the Appendices.

Analysis of latency scores

Means and standard deviations of MFF Latency scores are presented in Table 6. The analysis of variance of these scores is summarized in Table 7. The main effect A (sex) was not significant by the criteria set for the present research ($F = 3.69$; $df = 1, 66$; $p < .06$). It should be noted, however, that the effect closely approached the .05 criterion. Main effect B (treatment) was found to be highly significant in the present instance ($F = 15.16$; $df = 2, 66$; $p < .001$). In order to determine the significance of differences between pairs of means, the Scheffe method of making a posteriori comparison was used (Ferguson, 1966). The analysis revealed that while the Materials Only (M)) group was not significantly different in comparison to the Control (CG) group, the Television Modeling (TM) group was significantly different from both of these ($p < .01$).

The above results are taken to indicate that, with respect to the modification of the MFF Latency performances of impulsive subjects, the treatment found to be most effective was that in which a model demonstrated a successful task strategy. Using practice materials alone seemed not to

Table 6

Means and Standard Deviations of Posttest MFF Latency Scores in Study I

	Materials Only (MO) Group		TV Model (TM) Group		Control Group	
	Mean	SD	Mean	SD	Mean	SD
Male	7.75	2.64	12.26	4.94	7.58	2.98
Female	10.46	3.94	14.83	4.55	7.58	8.82

Table 7

Summary of Analysis of Variance for Posttest MFF Latency Scores

Source	SS	df	MS	F	p
Sex (A)	56.01	1	56.01	3.69	NS
Treatment (B)	460.06	2	230.03	15.16	.001
A x B	280.05	2	14.03	0.92	NS
Error	1001.23	66	15.17		
Total	1545.35	71			

be effective in helping impulsive children to take more time in task performance. This essentially was the finding of Meichenbaum and Goodman (1971) who, in a similar study, successfully increased the response latency of impulsive subjects by having them imitate verbally a set of task rules modeled by an adult male experimenter.

Analysis of error scores

Means and standard deviations of MFF error scores are presented in Table 8. The analysis of variance of these results is summarized in Table 9. The main effect A (sex) was not significant and there was no significant interaction. The main effect B (treatment) was highly significant (F = 13.73; df,= 2, 66; $p <$ .001). The Scheffe analysis revealed that, while the MO group is not significantly different from the Control group, the TM group is significantly different from both of them ($p <$ .05).

As was the case with MFF Latency scores, the most effective means of improving MFF Accuracy is by modeling the successful strategy and allowing subjects to immitate and practice it. This is a particularly significant finding in view of the fact that, while it appears to be a relatively easy matter to increase the response latencies of impulsive children, improving their levels of accuracy has proved to be another matter (e.g., Debus, 1970; Denney, 1972; Briggs & Weinberg, 1973). Teaching effective scanning strategies by the method used in the present study appears to have provided a relatively easy method of improving both the speed and accuracy scores of impulsive subjects on the MFF test.

Table 8

Means and Standard Deviations of Posttest MFF Accuracy Scores in Study I

	Materials Only (MO) Group		TV Model (TM) Group		Control Group	
	Mean	SD	Mean	SD	Mean	SD
Male	11.33	4.38	6.17	3.56	12.50	2.11
Female	7.67	4.16	6.83	4.71	11.50	1.93

Table 9

Summary of Analysis of Variance for Posttest MFF Accuracy Scores

Source	SS	df	MS	F	p
Sex (A)	32.00	1	32.00	2.41	NS
Treatment (B)	364.00	2	182.00	13.73	.001
A x B	57.33	2	28.67	2.16	NS
Error	874.67	66	13.25		
Total	1328.00	71			

Analysis of word recognition scores

The Words subtest of the Gates-McKillop Reading Test has been included here as a measure of the extent to which MFF performance gains might generalize to another visual processing task.

Means and standard deviations of Words reading scores are presented in Table 10. The analysis of variance of these results is summarized in Table 11. It may be seen at a glance that neither of the main effects nor the interaction approached significance. In short, improved MFF performances did not generalize to the Words reading task.

There is more than one way to view this finding. The first, however, would seem to be the most realistic. As stated previously, the mean reading score during the pretraining session was three-quarters of a grade above the expected level for a group of fourth year students. In addition, there was no significant relationship between reading scores and MFF Latency nor between reading and MFF Accuracy. This might be taken as an indication that not only are children in this group superior at word recognition, but also that cognitive tempo does not play a part in tasks of this type. It might be that in situations where a subject is both impulsive and a poor reader strategy training would have a generalized effect. This suggestion is yet to be pursued. A further speculation in this respect relates to the IQ-MFF problem. It might just be the case that in studies finding significant relationships between IQ and MFF variables, the low IQ measure may be more a reflection of poor reading ability than of an impulsive cognitive tempo. Speculation aside, it seems that in the present instance the Word test was inappropriate due to a "ceiling effect" and it will require a more

Table 10

Means and Standard Deviations of Posttest Word Reading Scores in Study I

	Materials Only (MO) Group		TV Model (TM) Group		Control Group	
	Mean	SD	Mean	SD	Mean	SD
Male	69.54	11.50	72.38	9.47	66.46	7.91
Female	68.33	7.02	70.04	7.96	66.17	11.44

Table 11

Summary of Analysis of Variance for Posttest Word Reading Scores

Source	S	df	MS	F	p
Sex (A)	29.56	1	29.56	0.33	NS
Treatment (B)	288.50	2	144.25	1.64	NS
A x B	12.50	2	6.25	0.07	NS
Error	5808.19	66	88.00		
Total	6138.75	71			

elaborate series of reading tests to explicate the relationship between this variable and impulsivity. A suggestion for further development of remedial materials might be appropriate here. It is one thing to postulate a similarity between the ways in which information is processed on different tasks. Thus, one might hypothesize that similar scanning strategies are used in reading as in match-to-sample tasks. It is quite another thing, however, to translate this hypothesis into specific remedial suggestions. Given that strategy training could improve the performance of poor readers, then materials used should closely approximate those prevalent in the skill to be acquired or improved. Rather than using match-to-sample complex geometric designs exclusively, then, one might "fade" these designs into ones having a closer and closer approximation to letters, words and sentences. It would probably be of benefit here to have the model attend to and note the structural resemblance between the two types of task.

Summary of the experiment

The present experiment has shown that the use of a televised model to demonstrate appropriate task strategies to impulsive children, in addition to giving these children the opportunity to practice the strategies, has a marked effect upon performance of the Matching Familiar Figures Test (MFF). Impulsive subjects in the Television Modeling (TM) condition significantly improved on the MFF, increasing the length of time prior to response and committing fewer errors. The effect did not generalize to a word recognition test and it was suggested that this test was inappropriate for the present sample of subjects.

Study II

Description of sample

Means and standard deviations of session one test scores are presented in Table 12. In most respects (i.e., with regard to test scores), the children taking part in the present study are quite comparable to those in Study I. Verbal and nonverbal Lorge-Thorndike subtest scores were available in this instance, allowing for a somewhat more detailed statement regarding the interrelationship of variables.

The results of the correlational matrix computed for the ten variables in the present study are presented in Table 13. In view of the similarities of findings between Studies I and II, the present results will not be considered at length.

Table 12

Means and Standard Deviations
of Variables and Tests
Administered in Session 1 of Study II

Variable	Mean	SD
Age (months)	116.7	3.20
MFF latency	14.1	6.30
MFF error	9.5	4.70
Words reading	72.2	7.10
Lorge-Thorndike (verbal)	113.1	10.90
Lorge-Thorndike (nonverbal)	111.3	13.00
Lorge-Thorndike (full scale)	112.3	10.80
Raven's (accuracy score	29.9	4.20
Hyperkinesis	17.5	7.90

Table 13

Intercorrelations of Pretraining Measures
in Study II

	1	2	3	4	5	6	7	8	9	10
1. Age		.002	.128	-.089	.073	.053	.128	.130	.092	-.104
2. Sex			-.100	-.086	.074	.045	.027	.039	-.076	-.371
3. MFF latency				-.288	.138	.091	.096	.085	-.142	-.196
4. MFF accuracy					-.058	-.221	-.211	-.228	-.143	.103
5. Word reading						.668	.383	.581	.114	-.205
6. Lorge-Thorndike (verbal)							.655	.912	.366	-.097
7. Lorge-Thorndike (nonverbal)								.896	.510	-.293
8. Lorge-Thorndike (full scale)									.501	-.202
9. Raven's Matrices										-.145
10. Hyperkinesis										

p .05; r = .205
p .01; r = .267
df = 92

Once again, boys were rated as higher in hyperkinetic behavior than girls, emphasizing the need for a thorough analysis of the situational variables which differentially affect boys and girls. Hyperkinetic behavior is implicated in many types of learning problems. Presumably boys exhibit more of these problems than do girls. If, in fact, there are situational determinants of this type of behavior, then to isolate and control them might act as somewhat of a preventative against future occurrences of these behaviors.

MFF Latency seems not to be related to Reading, Lorge-Thorndike or Raven's Matrices scores. Latency scores are once again marginally related to Hyperkinesis ($r = .20$; $\underline{p} < .05$). MFF accuracy scores in this instance are not related to Hyperkinesis, thus the former speculative analysis cannot be applied. It might be noted here that a coefficient in the .20 range covers a relatively small proportion of variance and as such should be treated conservatively.

While Latency and Lorge-Thorndike scores seem to be unrelated, MFF Accuracy and the three Lorge-Thorndike scores are all significantly and negatively correlated, suggesting once again that accuracy bears a greater relationship to IQ measures than does speed. And it is of crucial importance that these relationships be clarified, since at present it is difficult to interpret the findings of cognitive-tempo studies which do not control the IQ variable.

A suggestive finding in the present matrix is that Lorge-Thorndike "nonverbal" IQ scores are negatively correlated with Hyperkinesis ratings ($r = -.293$; $\underline{p} < .01$) and with MFF Accuracy ($r = -.211$; $\underline{p} < .05$), but not with MFF Latency. The latter finding is in disagreement with that

of Kagan et al. (1964) who suggest that MFF response latency is positively correlated with nonverbal measures of intelligence. If, in fact, Accuracy is the most importance variable vis a vis IQ scores, then perhaps the speed factor is simply an artifact of more accurate processing strategies. If this might be applied to the classroom situation, the child who is less accurate is likely to find the school experience frustrating. One might speculate, therefore, that the less accurate child on match-to-sample tasks is the same child who is generally inaccurate in school work. Thus, school is largely an aversive situation. In this analysis, then, Hyperkinetic behavior may be seen as a result of a series of avoidance behaviors developed to reduce tensions.

The above suggestion implies that by focusing upon the speed variable in MFF research, there is the possibility that researchers, at least to some extent, have been lax in dealing with the accuracy variable which might in fact be the crucial one with regard to cognitive impulsivity.

Experimental session

Recent attempts to modify cognitive tempo have been devoted to changing the task strategies of youngsters who are fast and inaccurate. A number of methods have been developed toward this end: Differential Reinforcement (Briggs & Weinberg, 1973), Modeling (Debus, 1970), Cognitive Self-Instruction (Meichenbaum & Goodman, 1970), and Direct Intervention (Zelniker, Jeffrey, Ault, & Parsons, 1972). These methods have had varying degrees of success.

The present experiment is a partial replication of that performed

by Zelniker et al. (1972). The simplicity of the intervention technique used in the latter study lends it an obvious utility. For a number of methodological reasons cited earlier, however, the technique should be re-evaluated.

From the data obtained in session one, a sample of "impulsive" subjects was selected for participation in the experimental study (N = 32). Of these, 16 (8 boys and 8 girls) subjects were randomly assigned to either a Control group or to the Discriminating Familiar Figures (DFF) group.

A two-way analysis of variance was performed on the data to determine whether the treatment condition had an effect upon performance and whether there was a differential effect for male and female subjects. A posttest only control group design was used once again and "pretest" data may be found in the Appendix section.

Analysis of latency scores

Means and standard deviations of MFF Latency scores are presented in Table 14. The analysis of variance of these scores is presented in Table 15.

While the main effect A (sex) and the interaction were not significant, the main effect B (treatment) was highly significant (F = 17.8; df = 1, 28; $p < .001$). Following the treatment session, Latency periods of subjects in the experimental condition were significantly longer than those of the Control group. This finding is not congruent with that of Zelniker et al. (1972) where experimental subjects did not exhibit an increased response latency following treatment. It is suggested that a possible reason for this discrepancy

Table 14

Means and Standard Deviations
of Posttest MFF Latency Scores
in Study II

	Experimental Group		Control Group	
		SD		SD
Male	15.88	3.80	9.75	3.45
Female	15.94	3.97	10.63	4.07

Table 15

Summary of Analysis of Variance
for Posttest MFF Latency Scores

Source	SS	df	MS	F	p
Sex (A)	1.76	1	1.76	0.12	NS
Treatment (B)	261.63	1	261.63	17.85	.001
A x B	1.32	1	1.32	0.09	NS
Error	410.47	28	14.66		
Total	675.18	31			

is inherent in the nature of the impulsive groups in both of these studies. The mean response time in the Zelniker et al. study was 17.4 seconds, while in the present study it was approximately 11.5 seconds. Impulsive subjects in the former study have the longest mean latency time reported in the literature and it is suggested that this was an "atypical" group.

Analysis of accuracy scores

Means and standard deviations of MFF Accuracy scores are presented in Table 16. The analysis of variance of these scores is summarized in Table 17.

Once again, there is no main effect due to sex nor is there a significant interaction effect. The main effect due to treatment was highly significant (F = 19.2; df = 1, 28; $p < .001$). Following a treatment session using the Discriminating Familiar Figures Test, experimental subjects committed significantly fewer errors on the MFF than those in the Control group. This finding is essentially in line with that of Zelniker et al. (1972) and as such adds credibility to the DFF technique.

Analysis of words reading

Means and standard deviations of Words Reading scores are presented in Table 18. The analysis of variance of these scores is summarized in Table 19.

There are no significant main effects nor does the interaction effect approach significance with regard to Word Reading scores. This finding merely substantiates the suggestion from Study I that the present

Table 16

Means and Standard Deviations of Posttest MFF Accuracy Scores in Study II

	Experimental Group		Control Group	
	Mean	SD	Mean	SD
Male	7.25	1.83	12.00	3.85
Female	6.63	1.60	10.50	3.34

Table 17

Summary of Analysis of Variance for Posttest MFF Accuracy Scores

Source	SS	df	MS	F	p
Sex (A)	9.03	1	9.03	1.16	NS
Treatment (B)	148.78	1	148.78	19.18	.001
A x B	1.53	1	1.53	.192	NS
Error	223.38	28			
Total	382.72	31			

Table 18

Means and Standard Deviations
of Posttest Word Reading Scores
in Study II

	Experimental Group		Control Group	
	Mean	SD	Mean	SD
Male	71.19	8.34	72.63	5.16
Female	73.94	6.18	72.44	6.97

Table 19

Summary of Analysis of Variance
for Posttest Word Reading Scores

Source	SS	df	MS	F	p
Sex (A)	13.05	1	13.05	0.29	NS
Treatment (B)	7.03	1	7.03	0.02	NS
A x B	17.26	1	17.26	0.388	NS
Error	1244.38	28	44.44		
Total	1281.72	29			

test is too easy for these children and thus does not differentiate them in terms of reading ability. It was suggested earlier that the recent emphasis upon phonics training might account for the above-average ability of children to pronounce words accurately. This does not mean, however, that they have greater ability in connecting words together in meaningful ways. And perhaps it is in this area that impulsive children might be deficient. This is yet to be demonstrated. As they stand, the present findings do not lend support to the contention of Lubus (1974), who indicated that there is a direct relationship between impulsivity and the acquisition of initial reading skills. Nor do they support Kagan's (1965) finding that with the effects of verbal ability partialed out, Word Recognition scores were negatively correlated with response speed and positively with response accuracy on the MFF. They do find agreement with Lesiak (197), King (1972) and Woker (1970) to the effect that there is no relationship between cognitive impulsivity and reading ability. The latter statement should be amended to include Lesiak's (1970) finding that when the most impulsive subjects were considered separately, then impulsives performed significantly more poorly than reflectives on all reading tests. It might be that many children who experience reading difficulties would be rated as "most impulsive" on the MFF. The efficacy of this suggestion is yet to be determined. If this is the case, however, perhaps scanning strategy training would be of benefit. A complete analysis of reading achievement level, taking into account verbal and nonverbal IQ factors and MFF variables, would provide a base for a comprehensive statement on this issue.

Summary of the experiment

The present experiment has demonstrated the utility of a relatively simple intervention technique in modifying the visual information processing strategies of cognitively impulsive youngsters. Following a session in which subjects were administered a test similar in format but opposite in task requirements to the MFF, it was found that these subjects performed more slowly and more accurately than did Control subjects. These findings lent partial support to those of Zelniker et al. (1972) upon whose study the present experiment was based. Unfortunately, strategy training on a match-to-sample task had no generalized effect upon reading scores, reinforcing the contention that either the reading test was inappropriate (producing a "ceiling effect") or that cognitive impulsivity is not related to reading performance, at least with respect to the reading of discrete words.

CHAPTER V

SUMMARY AND CONCLUSIONS

Recently there has been the suggestion that the cognitive tempo dimension of Reflection-Impulsivity is implicated in various forms of "learning disabilities". Specifically, the suggestion was that hyperkinetic behavior and cognitive impulsivity are manifestations of the same syndrome (Keogh, 1971; Campbell, 1973; Epstein, Hallahan, & Kauffman, 1975). If, in fact, cognitive impulsivity and behavioral impulsivity are related, and both are implicated in poor school performance, then modifying the cognitive tempo may be of value in the amelioration of the entire syndrome.

Implicit in R-I theory is the assumption that children who are inaccurate in the performance of various criterion tasks (e.g., match-to-sample tests) commit a high rate of errors because they perform the tasks too quickly. It has been found, however, that while it is relatively easy to lengthen the response latencies of these children, error rates do not decrease concomitantly.

Recent research (Drake, 1970; Zelniker et al., 1972) has demonstrated that marked differences exist in the visual scanning strategies of reflective and impulsive subjects. Not only do impulsives scan visual data for a shorter period of time, but they do so less effectively than do reflective subjects.

The present research was designed primarily to assess the efficacy of two different methods of helping impulsive children develop more efficient and hopefully more effective visual information processing strategies. One method (Study I) allowed impulsive children to view

a young televised model display and describe a successful task strategy. Following the demonstration, experimental subjects were encouraged to apply a similar strategy to a series of specially constructed practice materials. It was found that this intervention technique significantly improved the performance of both male and female experimental subjects relative to their controls. In addition, it was found that simply allowing children to use the practice material did not significantly improve performance on the posttest MFF administration. The second method (Study II) presented experimental subjects with a task that was similar in format but opposite in requirements to the Matching Familiar Figures Test (MFF). Implicit in this technique was the assumption that subjects respond to similar tasks in a stereotypic manner. By reversing the task requirements, subjects were forced to break this habit of responding. Results indicated that while there was no differential effect of treatment upon male and female subjects, both groups improved in their posttest MFF performances relative to their controls.

In relating the cognitive tempo dimension of Reflection-Impulsivity to school problems, it was hypothesized that an improvement in visual scanning strategies would be accompanied by an improvement in the accuracy of Words reading. The reasoning here was that they are both complex visual processing tasks and probably require similar strategies. In neither of the studies, however, was the slightest indication of improved reading scores in evidence. We had, in short, a rhyme without a reason. A number of possibilities could account for these findings, however, the most realistic of which seemed to be that the task was

inappropriate for these children. That is, it was too easy, thus producing a "ceiling effect". It was suggested that the emphasis upon phonics in the teaching of reading in recent years might account for the superior word reading performance of these children and that future research in the area must of necessity make use of more thorough and appropriate assessment devices. It was further suggested that not all "impulsive" children have reading problems. Thus, in the case of a child who is both impulsive and experiencing reading difficulties, perhaps the development of scanning strategies would be of assistance, particularly if the remedial materials used were similar to those used in the development of reading skills.

In general, the two experimental studies have demonstrated practical methods of modifying the visual processing strategies of impulsive youngsters. Whether they will be of utility in the amelioration of learning problems is yet to be demonstrated.

A second focus of the present research was to assess the interrelationships of MFF speed and accuracy variables with Lorge-Thorndike and Raven's Matrices IQ scores, Words reading scores, and a teacher's rating of hyperkinetic behavior. It was found that:

1. Boys are rated by teachers as being significantly more hyperactive than girls, and it was emphasized that recent research has indicated that this is largely a "situation-specific" variable. If these situational variables could be isolated, perhaps the incidence of hyperactivity among boys might be reduced or at least redirected into channels more acceptable to teachers.
2. There were no sex differences with regard to any of the other variables.

The literature with respect to MFF performance and sex differences is unclear. For example, while Lewis et al. (1968) found no sex differences in either response time or accoracy, Cathcart and Leidke (1973) and Souch (1970) have found "consistent differences" between males and females on both of these variables. Until this relationship is clarified, one would be well advised to treat these data discretely.

3. While MFF accuracy scores were negatively related to Lorge-Thorndike (verbal and nonverbal), Raven's Matrices, Words reading and positively related to the Hyperkinesis rating, MFF Latency scores correlated only with Hyperkinesis (negatively). These findings add to an already growing confusion regarding the relationships of MFF variables to such others as IQ (see, for example, Eska & Black, 1971) and merely underline the need for clarification of these issues.

The findings do suggest two things, however:

1. Though its nature is still unclear, there does seem to be a relationship between cognitive impulsivity and ratings of hyperkinesis;
2. The crucial variable in the Reflection-Impulsivity dimension seems to be accuracy rather than speed, and it is suggested that the speed variable is simply an artifact of the information processing strategies used by reflective and impulsive children.

A relationship between cognitive impulsivity and learning problems is an attractive one. It suggests, for example, that children who are experiencing school difficulties might be the same ones who are inaccurate on the MFF test. Such inaccuracies perpetrated in the school setting over a long period of time could result in the development of a series

of avoidance strategies to cope with an aversive situation. Avoidance strategies and hyperactivity in this light might to a certain extent be synonymous. Thus, a program which assists children in dealing more effectively with information might be of value in reducing the need for these seemingly inappropriate behaviors. In view of this, a thorough study of the above relationships seems warranted.

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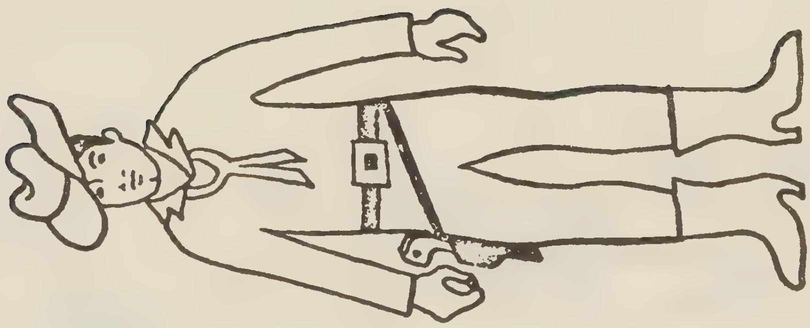
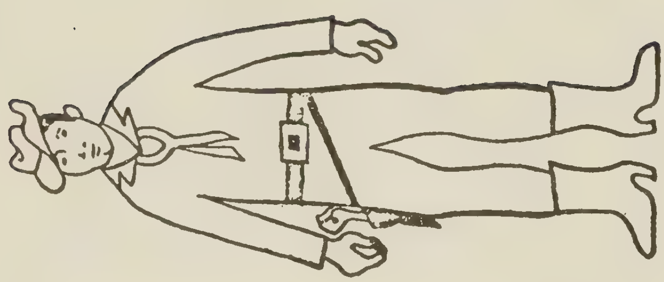
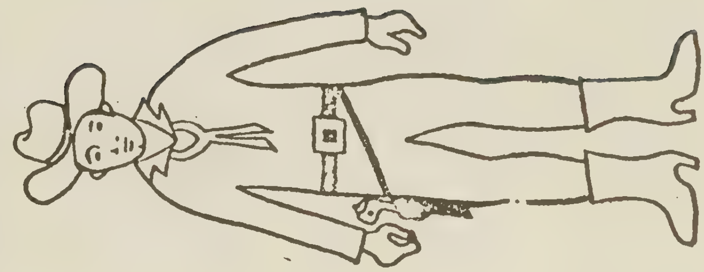
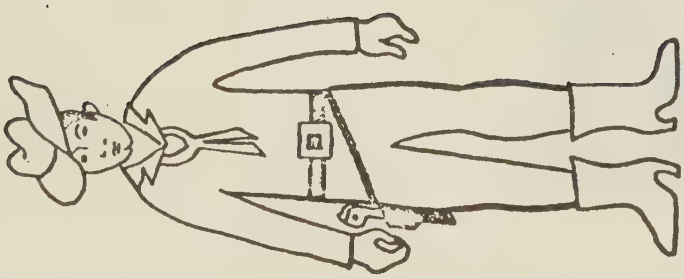
APPENDIX A

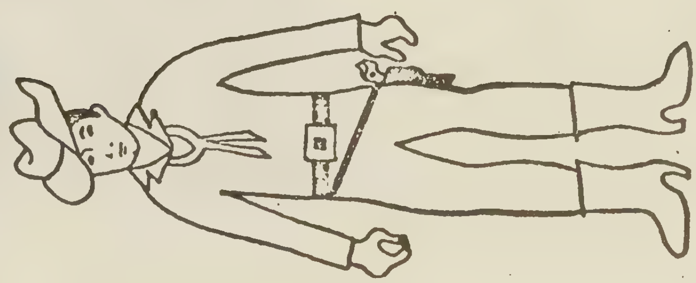
MFF Directions and Examples

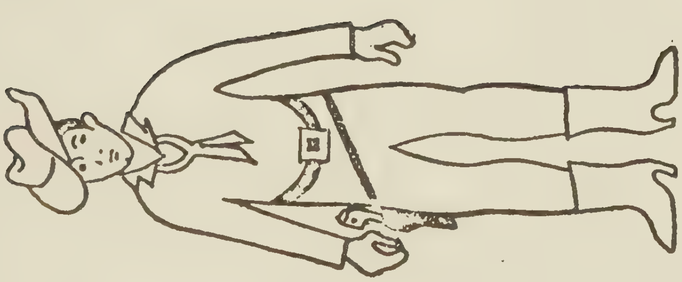


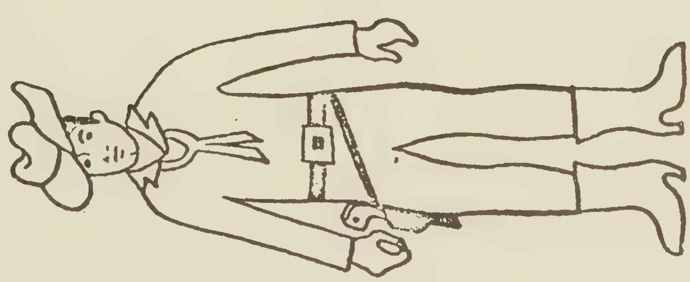


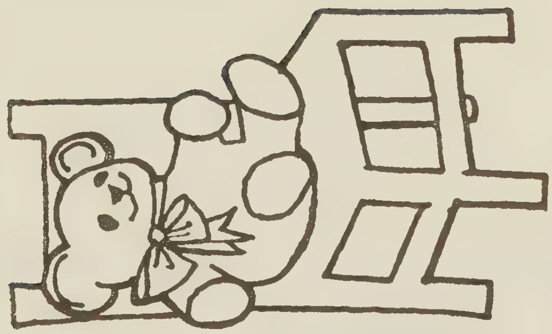


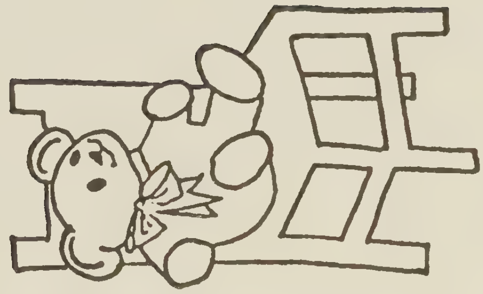


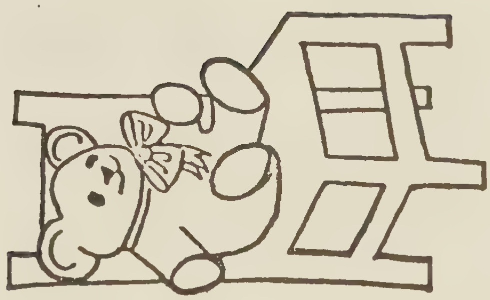


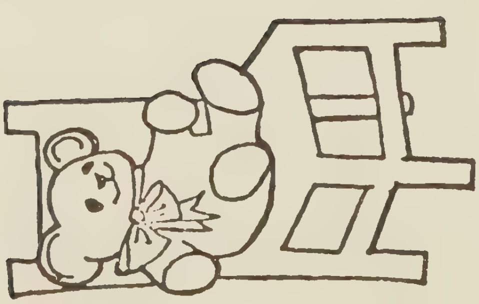


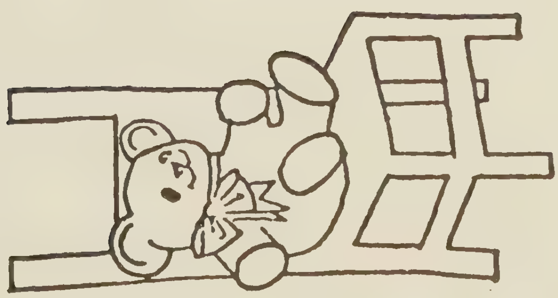






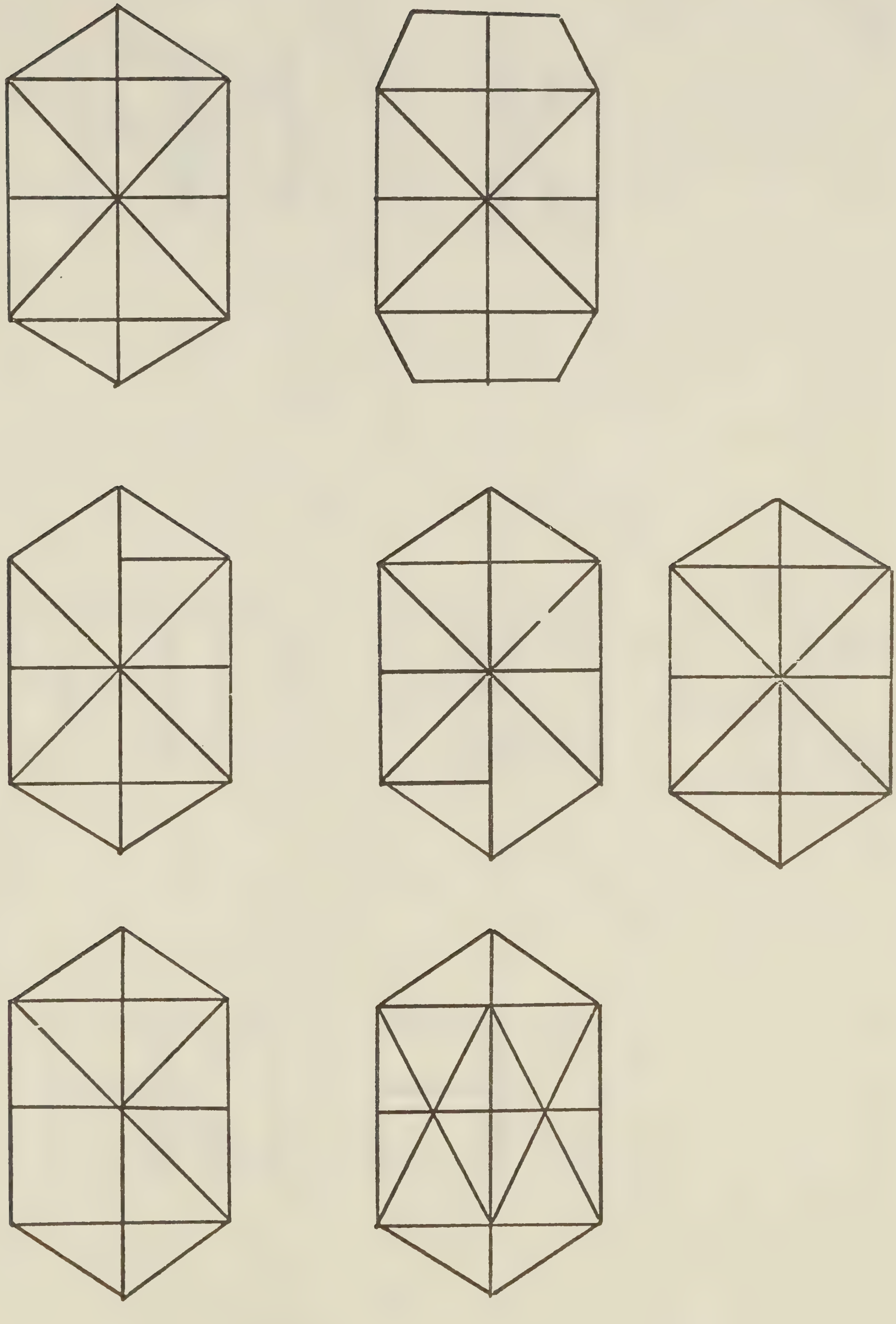


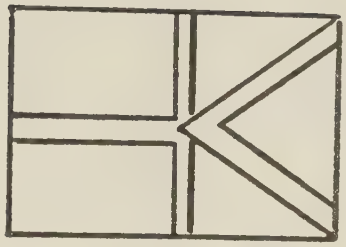
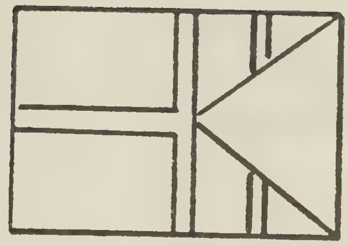


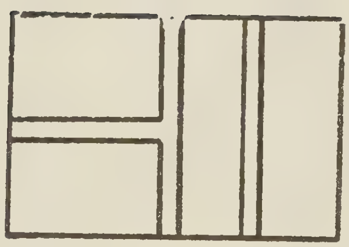
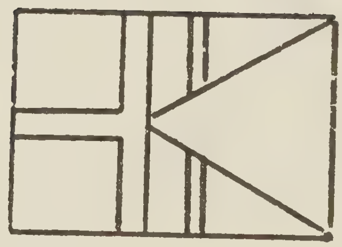
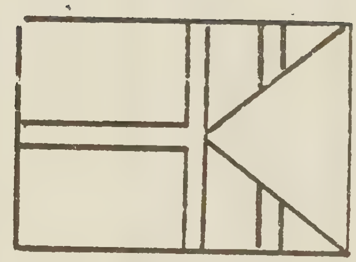


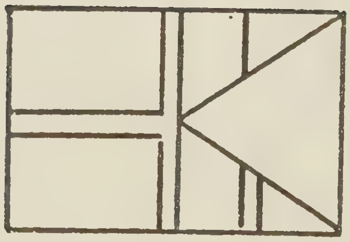
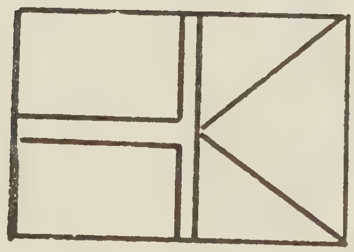
APPENDIX B

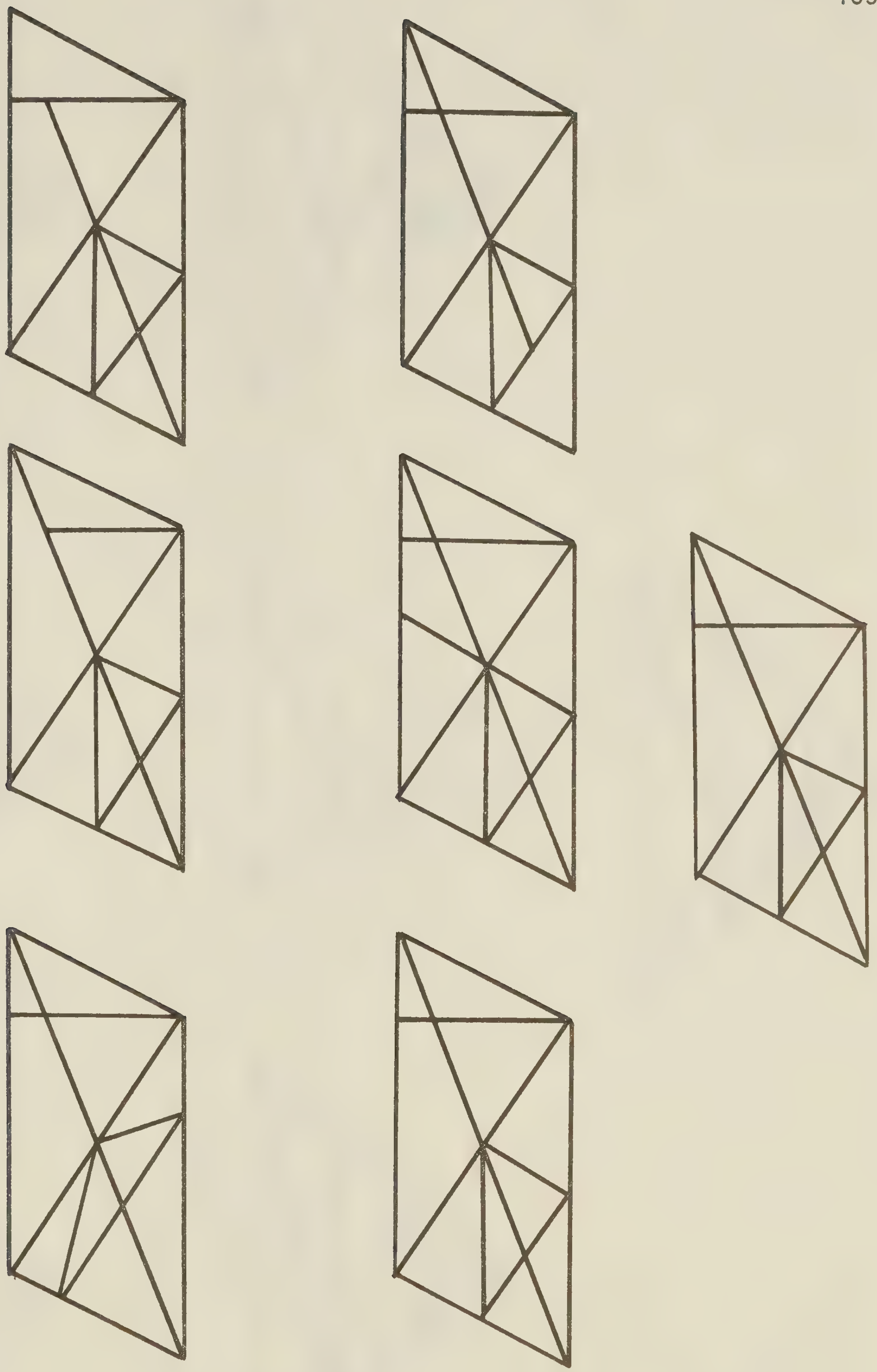
Examples of Training Materials

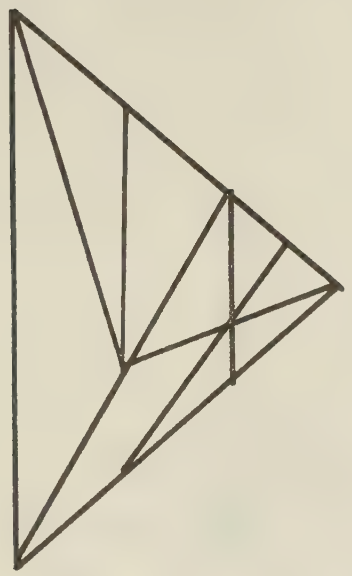


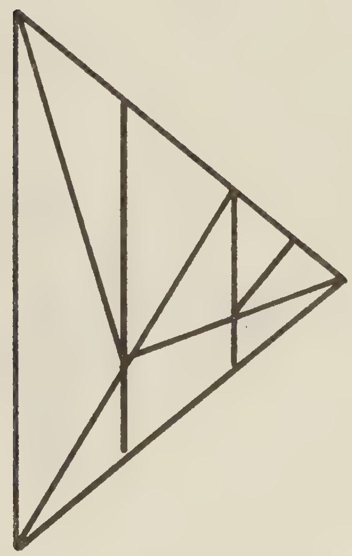



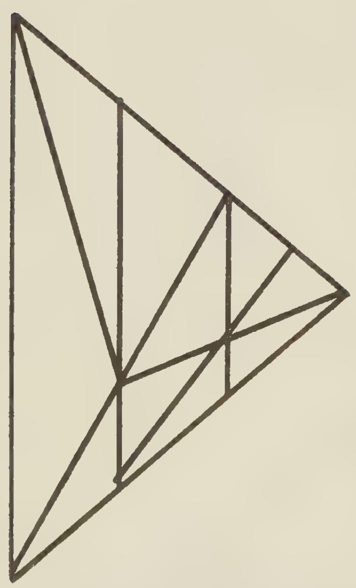




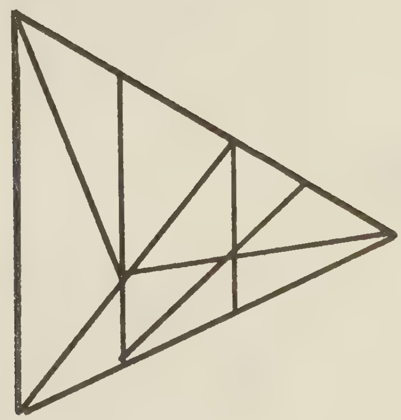



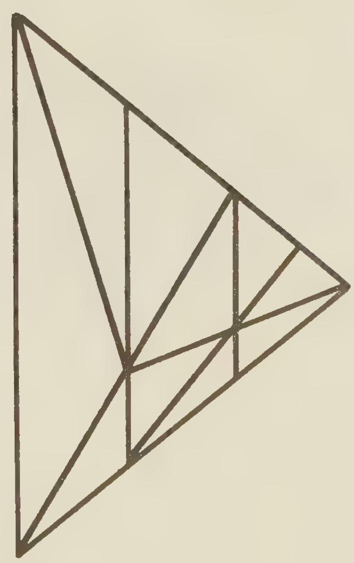


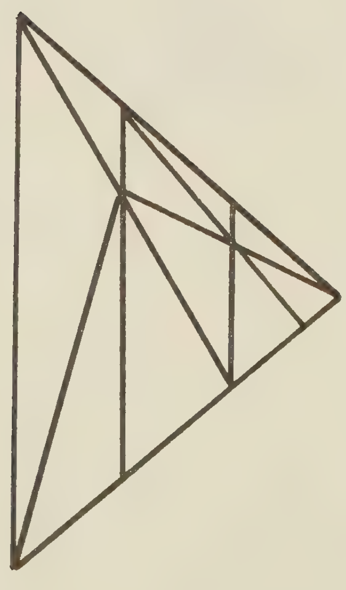


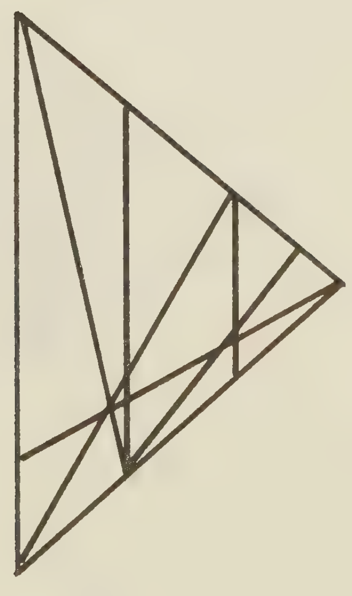


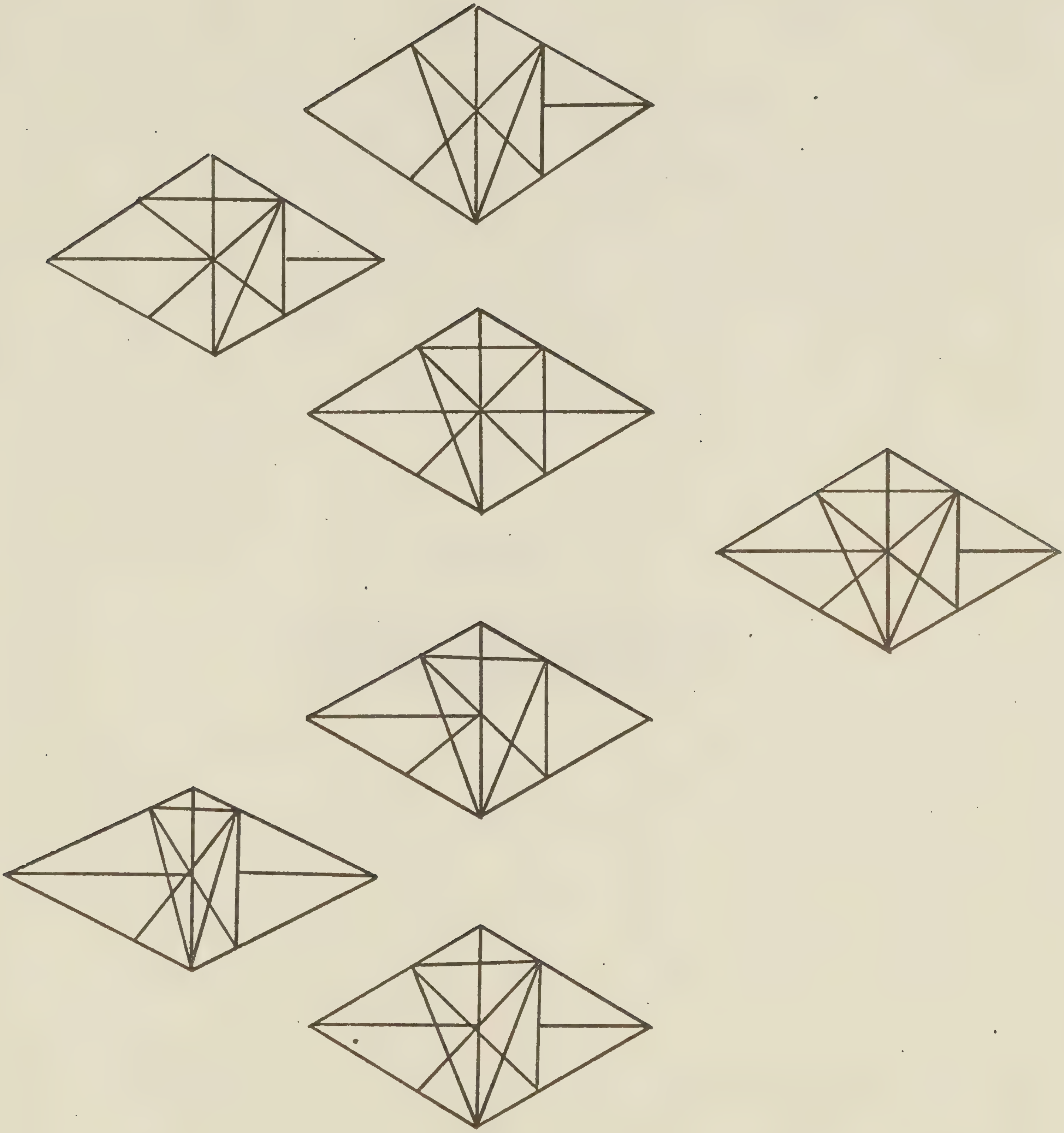












APPENDIX C

Means, Standard Deviations
and Analysis of Variance Summaries
of Pretest Data in Study I

Table C-1

Means and Standard Deviations of Pretest

	Materials Only (MO) Group		TV Model (TM) Group		Control Group	
	Mean	SD	Mean	SD	Mean	SD
Male	6.92	1.79	6.42	2.19	7.42	2.17
Female	7.10	2.25	7.50	1.64	6.42	1.81

Table C-2

Summary of Analysis of Variance
for Pretest MFF Latency Scores

Source	SS	df	MS	F	p
Sex (A)	0.13	1	0.13	0.03	.86
Treatment (B)	8.91	2	4.46	0.01	.99
A x B	13.08	2	6.54	1.65	.20
Error	261.58	66	3.96		
Total	283.70	71			

Table C-3

Means and Standard Deviations of Pretest
MFF Accuracy Scores in Study I

	Materials Only (MO) Group		TV Model (TM) Group		Control Group	
	Mean	SD	Mean	SD	Mean	SD
Male	13.00	3.57	13.50	4.27	13.67	3.05
Female	13.33	3.11	13.00	2.89	12.50	2.97

Table C-4

Summary of Analysis of Variance
for Pretest MFF Accuracy Scores

Source	SS	df	MS	F	p
Sex (A)	3.56	1	3.56	0.32	.57
Treatment (B)	0.34	2	0.17	0.02	.98
A x B	6.78	2	3.39	0.30	.74
Error	739.34	66	11.20		
Total	750.02	71			

Table C-5

Means and Standard Deviations of Pretest
Word Reading Scores in Study I

	Materials Only (MO) Group		TV Model (TM) Group		Control Group	
	Mean	SD	Mean	SD	Mean	SD
Male	69.83	10.10	70.17	10.93	63.29	8.65
Female	66.38	7.32	69.67	8.81	66.78	11.11

Table C-6

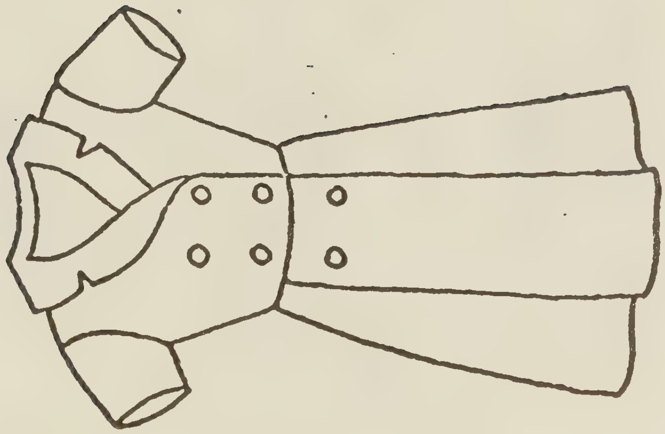
Summary of Analysis of Variance
for Pretest Word Reading Scores

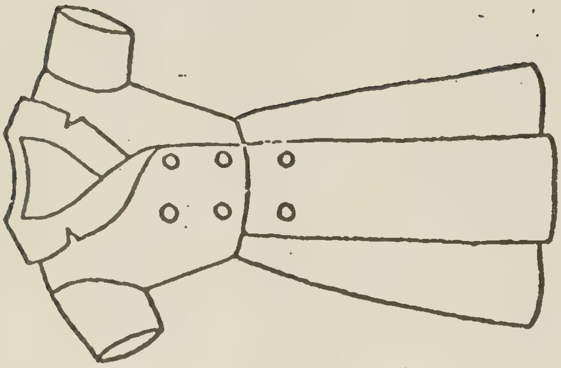
Source	SS	df	MS	F	p
Sex (A)	0.56	1	0.56	0.01	.94
Treatment (B)	291.75	2	145.88	1.59	.21
A x B	146.31	2	73.16	0.80	.45
Error	6061.63	66	91.84		
Total	6500.25	71			

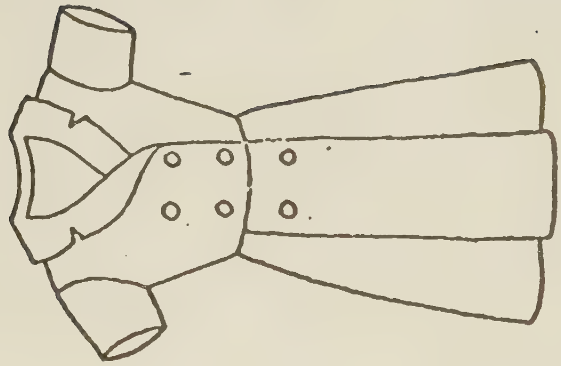
* = p .05
** = p .01

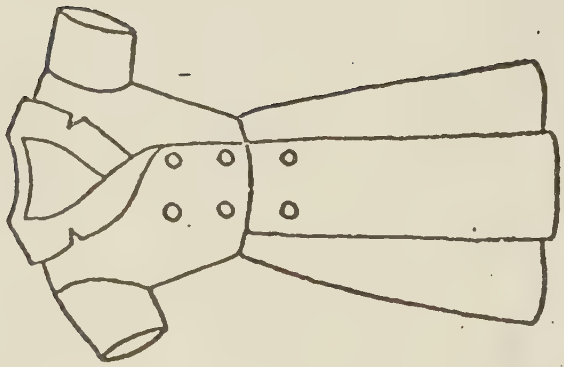
APPENDIX D

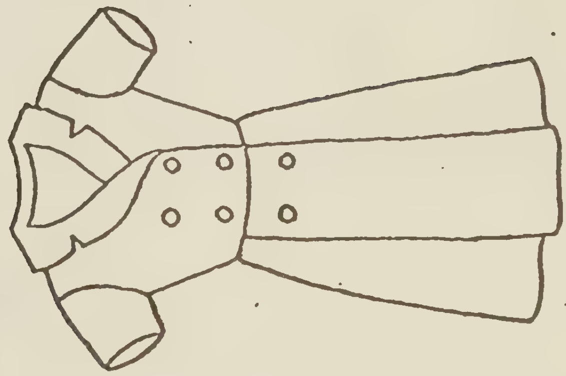
Examples of the DFF Test

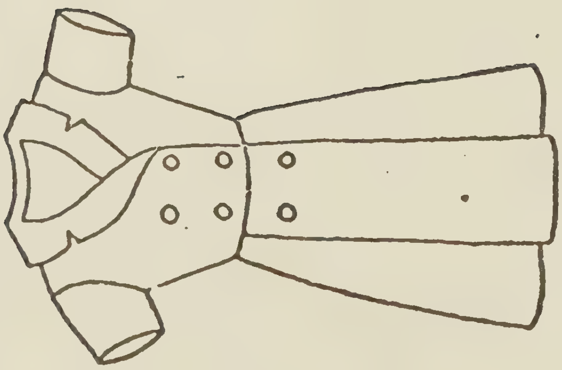


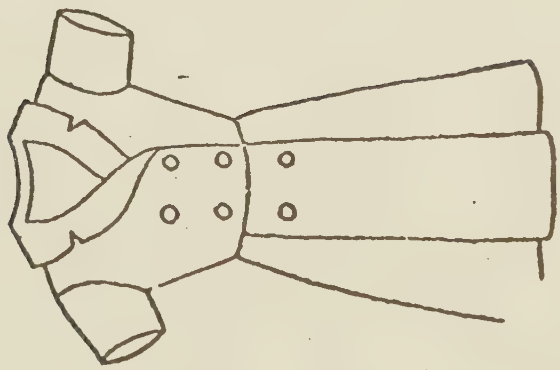


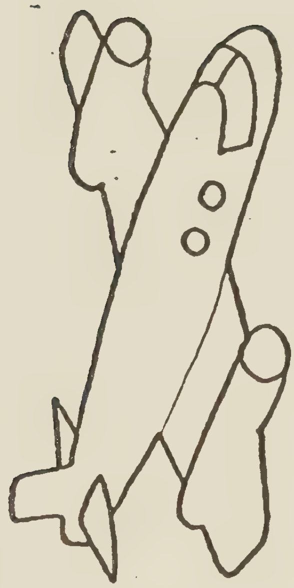


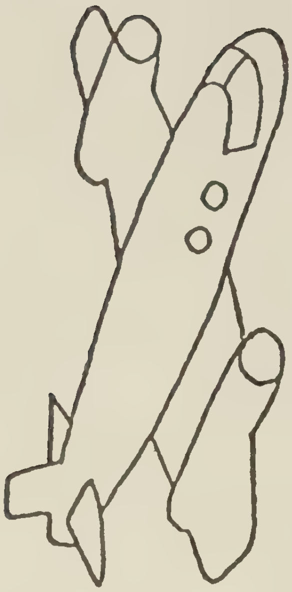


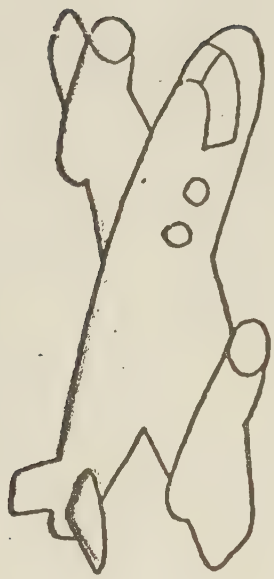


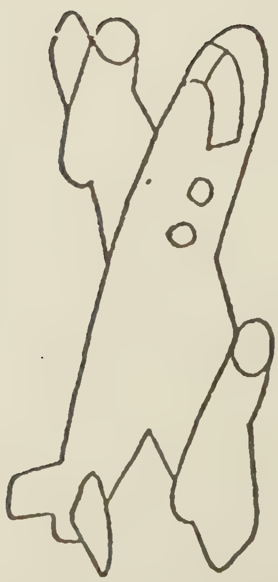












APPENDIX E

Means and Standard Deviations
and Analysis of Variance Summaries
of Pretest Data in Study II

Table E-1

Means and Standard Deviations
of Pretest MFF Latency Scores
in Study II

	Experimental Group		Control Group	
	Mean	SD	Mean	SD
Male	12.06	2.32	11.00	2.09
Female	11.38	2.01	9.63	2.43

Table E-2

Summary of Analysis of Variance
for Pretest MFF Latency Scores

Source	SS	df	MS	F	p
Sex (A)	3.84	1	3.84	0.41	NS
Treatment (B)	6.57	1	6.57	1.64	NS
A x B	.20	1	0.20	0.05	NS
Error	112.47	28	4.02		
Total	138.00	31			

 * = _p_ .05
** = _p_ .01

Table E-3

Means and Standard Deviations
of Pretest MFF Accuracy Scores
in Study II

	Experimental Group		Control Group	
	Mean	SD	Mean	SD
Male	12.50	2.07	12.75	3.01
Female	11.75	2.25	12.75	3.01

Table E-4

Summary of Analysis of Variance
for Pretest MFF Accuracy Scores

Source	SS	df	MS	F	p
Sex (A)	1.13	1	1.13	0.16	.69
Treatment (B)	3.13	1	3.13	0.45	.51
A x B	1.13	1	1.13	0.16	.69
Error	192.50	28	6.88		
Total	197.89	31			

* = p .05
** = p .01

Table E-5

Means and Standard Deviations
of Pretest Word Reading Scores
In Study II

	Experimental Group		Control Group	
	Mean	SD	Mean	SD
Male	70.88	9.05	70.88	7.39
Female	73.75	4.95	72.06	8.47

Table E-6

Summary of Analysis of Variance
for Pretest Word Reading Scores

Source	SS	df	MS	F	p
Sex (A)	32.99	1	32.99	0.57	.46
Treatment (B)	5.68	1	5.68	0.10	.76
A x B	5.70	1	5.70	0.10	.76
Error	1629.00	28	58.18		
Total	1673.37	31			

* = p .05
** = p .01